THE

ELECTRICAL REVIEW.

VOL. LXXI. DECEMBER 6, 1912. No. 1,828.

ELECTRICAL REVIEW.

Vol. LXXI.] CONTENTS: December 6, 1912. [No. 1,828.

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THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE :—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: Holborn 933; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 1s. 8d. ($5.30). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.
AUCKLAND, N.Z.: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 16, Palmerston Buildings, Queen Street.
BERLIN: Asher & Co., Unter den Linden; Speyer & Peters, Unter den Linden 43, N.W. 7.
BRISBANE: Gordon & Gotch, Queen St.
CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.
DUNEDIN, N.Z.: Gordon & Gotch, Princes Street.
JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.
LAUNCESTON: Gordon & Gotch, Cimitiere Street.
MELBOURNE: The Mining & Engineering Review, 90, William Street Gordon & Gotch, Queen Street.
MILAN: Fratelli Treves.
NEW YORK: D. Van Nostrand, 25, Park Place.
PARIS: Boyveau & Chevillet, 22, Rue de la Banque.
PERTH, W.A.: Gordon & Gotch, William Street.
ROME: Loescher & Co., Corso Umberto 1° 307.
SYDNEY: The Mining & Engineering Review, 2, Hunter Street; Gordon and Gotch, Pitt Street.
TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.
WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1913 EDITION

In Preparation.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

TERMINOLOGICAL INEXACTITUDE.

WHEN Mr. James Swinburne talked to the Institution of Electrical Engineers, on December 4th, 1902, about the Presidential Address which he had written, he related that, wishing to find out what entropy was, he asked Lord Kelvin. The reply was, "Well, entropy is a very bad name for it," and that was all Lord Kelvin said about it.

In *Engineering* for August 30th of this year, there was published an article entitled "Meta-mechanics: a Plea for Precision," and, even at this late date, we commend this article to the notice of our readers. Its general trend is a protest against slackness of definition, especially on the part of those whose duty it is to instruct the rising generation. Such slackness is only too likely to cause a confusion of ideas which is exceedingly difficult to get rid of in after life. Yet the tendency towards slackness is as natural as the confusion to which it gives rise.

The author of the article, who disguises himself under the title "An Old Millwright," takes objection, in the first place, to all talk of transference of motion from one body to another. Motion is a condition, and so cannot have a concrete existence. It is a property of anything which is not at rest, and a property—of this kind at all events—cannot be transferred.

In explaining this kind of idea to students, however, and showing, for instance, that when a billiard ball in motion runs against one which is at rest, the ball at rest moves and the moving one travels more slowly than before, a teacher is apt to seek for some homely and easily understood method of bring this notion home to his hearers. There are people who will not believe in any measurement that cannot be made with a pint pot. What is easier, then, than to represent what actually happens as the pouring of a portion of the motion of the moving ball into the one which is at rest? The fact is, that it is the dodging of difficulties instead of clearing them resolutely out of the road that is responsible for most of the ills which our understandings contract and suffer from. Our understandings are not heirs to such ills, although the expression comes naturally to the pen. To be heir to anything implies a right to its possession and an obligation to take up the duties attached to the possession of the estate. There is no obligation on anyone to take up foggy notions and try to make the best of them, and the student who does so is laying up ashes and dust instead of treasure in heaven. The word "student" in this connection includes not only the young man at college, but any engineer who still finds, as all ought to find, continued interest in the work which he is called upon to do; and who, while thankful for the mercies of the past, is anxious to see what to-day and to-morrow have in store, instead of wishing to live yesterday over again.

Let all such students, then, make up their minds to fight their difficulties and conquer them. Let them walk over the Hill Difficulty, instead of travelling by the level paths

which seem to be inviting them to circumvent it. The parallel holds good to the end, for one path led into a great wood—the wood of confusion of thought—and the other led into dark mountains, where the traveller stumbled and fell.

The writer of the article in question expressly states that he does not wish to appear pedantic; if it were not for this statement we should be inclined to think that occasionally he was striving after a meticulous and undesirable precision of expression which would leave one no latitude at all, and for the full carrying-out of which life itself would be too short. There can be no doubt, however, that it is well for all workers and thinkers, in whatever province of learning they may be engaged, to halt and take stock of their position. Those who read the article will in all probability be induced thereby to try to remove as many as possible of the weeds which thrive among their ideas, and to appreciate that there is a science of meta-mechanics, as there is one of metaphysics. It is "that which is beyond mechanics," as metaphysics is that which is beyond physics. It is only by looking beyond, in this way, that progress can be made, and it will ultimately be found that the series will converge, and that all the separate sciences, branches of learning, and subjects requiring understanding, will find their final solution in one great and supreme Mind.

But we are allowing ourselves to get beyond the province of a technical journal. Let us conclude by borrowing the concluding words of our author's plea for precision: "In the meantime, let everyone deal with facts as he finds them, making sure that he understands them, and not misleading himself or others by inventing explanations, however plausible, of the non-existent."

DEPARTMENTAL METHODS.

During the last few years employers of labour have gradually become accustomed to finding the Government ranged on the side of Labour in every trade dispute. So long as this formidable ally of the Trade Union comes out into the open, there is little to complain of. It is of the essence of party government that Ministers in power should actively support those who have put the reins of office into their hands. If the Trade Union is encouraged by Act of Parliament, or assisted by Government intervention in a dispute which may be pending, that is one thing; the employer at least has a visible foe to combat; but when a Government or a department seeks to bring pressure on employers by round-about methods—to use an inoffensive adjective—the case is very different.

An example of such methods has recently been brought to light. In 1911 a strike for a 50 hours' week was forced by the London Society of Compositors. This was while a conference was pending as to hours. The conference resulted in an agreement for 51 hours for the whole country outside London, the London Unions having broken away from the other Unions and called their men out. The London houses eventually conceded the 50 hours temporarily, pending an agreement between the Master Printers' Association and the Unions. No such agreement and no settlement has ever been arrived at. Two-thirds of the London printing houses are non-society houses, nearly all of which work more than 50 hours, and half the workpeople returned are working more than 50 hours per week.

The parties being thus in negotiation, the Government in July last invited employers in the printing and book-binding trades to furnish a return as to the weekly hours of labour. This was to "be regarded as hitherto as strictly confidential, and will be used only in the compilation of general statistical results."

Having got the necessary information by this means, the time arrived for Mr. Masterman to act, and on October 29th he announced that unless firms tendering for and undertaking Government printing would at once agree to reduce hours to 50 by January, 1913, they would no longer be regarded as qualified to contract.

Discussion in the House of Commons has elicited that this decision was arrived at because 50 hours was the period of employment predominating. Yet the Fair Wages Clause provides for an adjustment in accordance with the hours prevailing among good employers. It seems that according to the strange arithmetic of the present Government, the hours worked by 46 per cent. and 45 per cent. of the principal classes of men, the compositors and machine men, in some of the largest, best conducted and most important houses in the trade, are not "hours prevailing among good employers."

The results of the action of the Government in this matter are far-reaching. If 50 hours is declared to be the standard in houses which are doing work under Government contracts, how shall it ever be exceeded in any other house?

It is small wonder that the Master Printers' and Allied Trades Association should have passed a resolution protesting against this unprecedented and arbitrary action of the Government in intervening in the printing trade dispute. No such intervention was proper until after a full and impartial inquiry.

It only remains, as it seems to us, for the printing trade to hang together, and this unwarrantable move on the part of the Government can be checkmated. An example has recently been afforded by the action of the medical profession of the use of legitimate and effective methods of bringing pressure to bear upon a member of the Government. Could the printing world boast a similar unanimity, equally gratifying results could be attained.

London Traffic Developments.

The recent shuffle in ownership of London tube, tramway and omnibus undertakings has naturally attracted considerable attention in the daily Press, and many and various surmises have been made by different writers as to the causes and effects of the recent amalgamations. Thus, a correspondent in the *Morning Post* refers to the fresh competition possibilities created, the Speyer lines with their tramways and 'buses being arrayed against the Metropolitan, Great Northern and City group, behind which stand the Great Western and Great Central Railways, as joint owners of some portions of the Metropolitan lines; in view of this dependence of the latter railway, it is considered certain that the former railways would oppose any scheme for the acquisition of the Metropolitan. The future of the Great Northern and City, when physically connected to the Metropolitan, is also a matter for speculation; the *Standard* points out that an extension of this line northwards in competition with the Great Northern is prevented by agreement, but that in other directions there is scope for extension by its new owners, who have already notified their intention of prolonging the line citywards to the Bank, with a view to tapping the Waterloo and City railway traffic. Behind this there is the obvious suggestion that the Metropolitan and its big partners, in acquiring the Great Northern and City line, had far more in view than a link to Finsbury Park.

With regard to the Underground Co., which is purely a holding concern, and the railway, tramway and omnibus undertakings which it now controls, a writer in the *Daily Telegraph* considers the tramway combination the most interesting and significant part of the recent deal, and asks whether it means that the Speyer group has had enough of tramways, and is going to let somebody else give them a trial. The experience of the London United Tramways has not been a particularly happy one, and there are more promising ventures on hand at the present time. Under the new scheme the management of these tramways passes from Underground control to that of the Metropolitan Electric Tramways, while the 'bus subsidiary of the latter—the Tramways (M.E.T.) Omnibus Co.—passes under the management of the London General Omnibus Co., the earnings of the combined concern being shared with the two companies.

The amalgamated tramways will be known as the London and Suburban Traction Co., and the fact that the British Electric Traction Co. (from its holding in the Metropolitan Tramways) will be very largely interested in the new concern, leads to a suggestion by the *Daily News* that the opening up of closer relations between the B.E.T. is a possible development, while a *Times* correspondent infers that some of the provincial undertakings of the latter may be worth making a bid for.

With regard to the further two railways—the Central London and City and South London Railways—which will now be added to the Underground traction system, the former, if anticipations are correct, will greatly benefit in traffic by the linking-up of its Shepherd's Bush terminus with the Great Western line at Ealing, and its position will be further strengthened when the much-talked-of Thames Valley extension matures. The latter, it was generally understood, would be competitive with the South-Western lines in the same area; at any rate, it obtained local support on that hypothesis, but, judging by the recent notice given by the Central London Co. of its application for powers to build a line from Shepherd's Bush to Gunnersbury on the South-Western line, an understanding or an alliance appears to have been arranged which will not lead to the anticipated competition.

The original proposals have, however, served a good purpose if they are responsible for the recent announcement by the South-Western Co., of its intention to electrify the Kingston and Hounslow loop lines, and the Shepperton and Hampton Court lines, within two years.

The City and South London line, as our readers are aware, is to be modernised by its new controllers, that is to say, it will be reconstructed and re-equipped presumably on similar lines to the London Electric tube railways, and this is expected to take three years to complete. Rumour has it that this line will be physically connected with the Hampstead Tube (which is to be extended to Edgware), and that it may be extended towards Balham and Tooting, south of the Thames, thus giving another north and south route.

The District, another member of the group, has announced its intention, apparently, of absorbing the authorised Wimbledon and Sutton railway, and of constructing this line, which will tap a preserve of the Brighton Co., and may thus lead to further electrification by that company. Lastly, as it will be gathered that this amalgamation of interests all tends to the unified control of London traffic, much speculation naturally exists as to the future of the L.C.C. tramways when, and if, competition becomes more pronounced than at present. One writer regards as a plausible contingency the purchase by the Council of the joint system of the new tramway group, and it must be remembered that joint services are at present worked by the Council and the Metropolitan Tramways Co.

The Earthing of the Neutral.

The paper by Mr. J. S. Peck, which was read at the Institution of Electrical Engineers on November 28th, and is abstracted elsewhere in this issue, is noteworthy for several reasons. The first is that the author appears to have condensed into so short a space that it is difficult to summarise it any further, all the information available on this important subject. If, however, it were possible further to condense it, Mr. Peck himself did so in the admirable little speech with which he introduced it to the meeting. We have often urged that papers should be distributed to members in advance and introduced briefly at the meeting by the authors, and the excellence of this plan was well illustrated on this occasion. It may have appeared to some that practice was already so standardised, so cut-and-dried, that it would not be easy to impart any interest to the subject; but without intruding his own views too dogmatically, Mr. Peck has contrived to present the question in all its bearings, as it appears to him, and the widespread interest taken in the matter is evidenced by the fact that before the paper was read in London it had already been discussed by the members of the Local Sections of Manchester and Birmingham. It will also be discussed at Newcastle.

An interesting discussion took place, and we noticed with considerable pleasure the complete absence of a tone which prevailed some time ago, and which we may indicate by this sort of opening:—"I have not had time to read the paper myself, but if there is one individual in the whole of the electrical profession and industry who is abysmally ignorant of this particular question, it is the author of this paper; and whatever he does know, I taught him." Members who are not familiar with the contents of a paper, but who nevertheless presume to discuss it, are guilty of a grave discourtesy towards their fellow-members, and especially to the author.

Mr. Brazil suggested that it was desirable to insert between the neutral and earth a resistance with a negative temperature coefficient, and described one which was cheaply constructed, and which had been in use for a number of years, carbon powder being the principal constituent. Some years ago the British Thomson-Houston Co. used cylindrical resistances composed of a mixture of carbon and clay, in connection with spark-gaps used for minimising the effect of surges on the lines. This mixture had a negative temperature coefficient, and we should scarcely have thought that there was anything very novel in the idea. Mr. Brazil's design is more adaptable, perhaps, and certainly is inexpensive.

Mr. Partridge pointed out the desirability of providing a definite metallic path back to the generators, when the outer of a high-tension cable is earthed at the station, and the middle point of the transformer secondary is earthed at the sub-station. If a spark-gap is provided at the distant end of the high-tension line, between the outer and earth, then, in the event of a connection between the primary and the secondary of the transformer, there will be a metallic return *via* the spark-gap, obviating the necessity which would otherwise exist of a considerable flow of current through the earth to the station. The fact that Mr. Partridge, following the single-phase practice, earths one phase of his three-phase system throughout, and has had no trouble therefrom, is very interesting.

Of course Mr. Peck considers pressures of all magnitudes, and it was a sign of the times to hear him speak of 2,000 and 5,000 volts as "low voltage." It requires more than this, however, to justify Mr. Edgcumbe's animadversions on electrostatic voltmeters. Twelve years ago we were familiar with many examples of such instruments in use on ordinary low-tension circuits, and on circuits of 2,000 volts—and that was about as high as could readily be found in the United Kingdom at that time. We, therefore, fail to find justification for Mr. Edgcumbe's statement that 12 years ago electrostatic voltmeters were so unreliable as to be practically useless. Moreover, it is within our knowledge that in German practice of the last two or three years, the vogue of streaks of lightning, and skulls and crossbones, to which he referred, has ceased.

Mr. Trotter, who had already spoken at one of the sectional meetings, spoke again from the point of view of the safety of the public. We cannot agree with Mr. Peck that having the system entirely insulated obviates danger to human life, or even minimises it to any great extent. To run with one phase-wire earthed, as Mr. Chamen suggested, is much worse, from this point of view, than to run with an earthed neutral. But, after all, everyone knows that the live wires are dangerous, and it is only a question of degree. We remember that at a meeting held in Glasgow in 1901, concerned with railway work, Mr. Alexander Siemens said that he would have no notices of danger, but rather, "You may touch everything; it is perfectly safe." This can never be the case with live cables, and we are quite against any attempt to try to make them safe, except by treating them as dangerous, and taking all proper precautions. We are reminded of the "arguments" that used to be used in favour of insulating the frames of motors.

Our general impression of the evening's work was that while in most cases it is advisable to earth the neutral, yet local conditions must influence the matter considerably; and we think that engineers who are in charge of undertakings in which this system is used are, as a rule, fully alive to the necessities of the situation. A significant remark was let fall by Mr. Trotter with reference to overhead mains—namely, that the adoption of these would be facilitated in districts where they are not at present permitted, if the neutral point were earthed through a resistance and a trip coil cutting off the mains at a low current.

ELECTRIC TRAVELLERS.

Travelling cranes are as a general rule fitted with three or more motors. If three are employed, the first is for hoisting, the second for cross traverse, and the third for longitudinal motion.

Supposing it to be a four-motor crane, the arrangement is, first, for main hoisting; secondly, for auxiliary hoisting; thirdly, for cross traverse; and fourthly, for longitudinal motion.

The main hoist motor is geared to the large barrel of the crab, and is used for ponderous work. The gearing of this barrel is often arranged to allow two speeds by the movement of a lever, which can be operated from the cab of the crane. The auxiliary motor is geared to a smaller barrel, and lifts the lighter loads or assists the main hoist, being entirely separate from other parts of the crab as far as gearing is concerned. The cross traverse motor is also fitted on the crab, and is geared to the wheels which carry the crab along the girders. The longitudinal motion motor is fitted to the centre of the main girder. Frequently two crabs are erected on one pair of girders, which would make a total of seven motors on one crane, *i.e.*, three on each crab, and one longitudinal traverse motor which is fitted to the main girder. To supply current to the motors on the crabs, collectors are fitted under the crab and make connection with the motor leads by sliding contact. These collectors are shown in the accompanying drawing at A, B, C, D. The

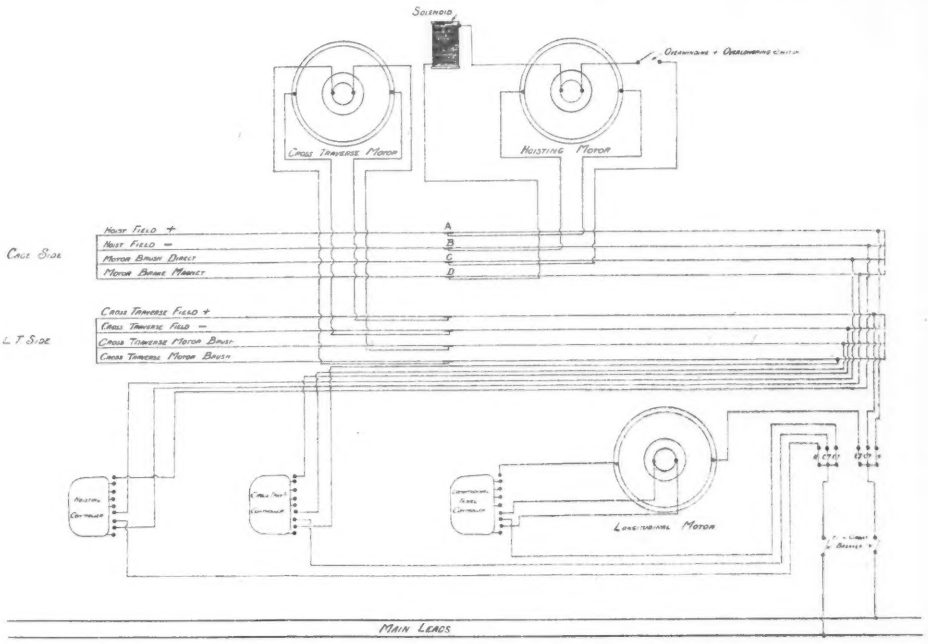

Diagram of Connections of Direct-Current Crane.

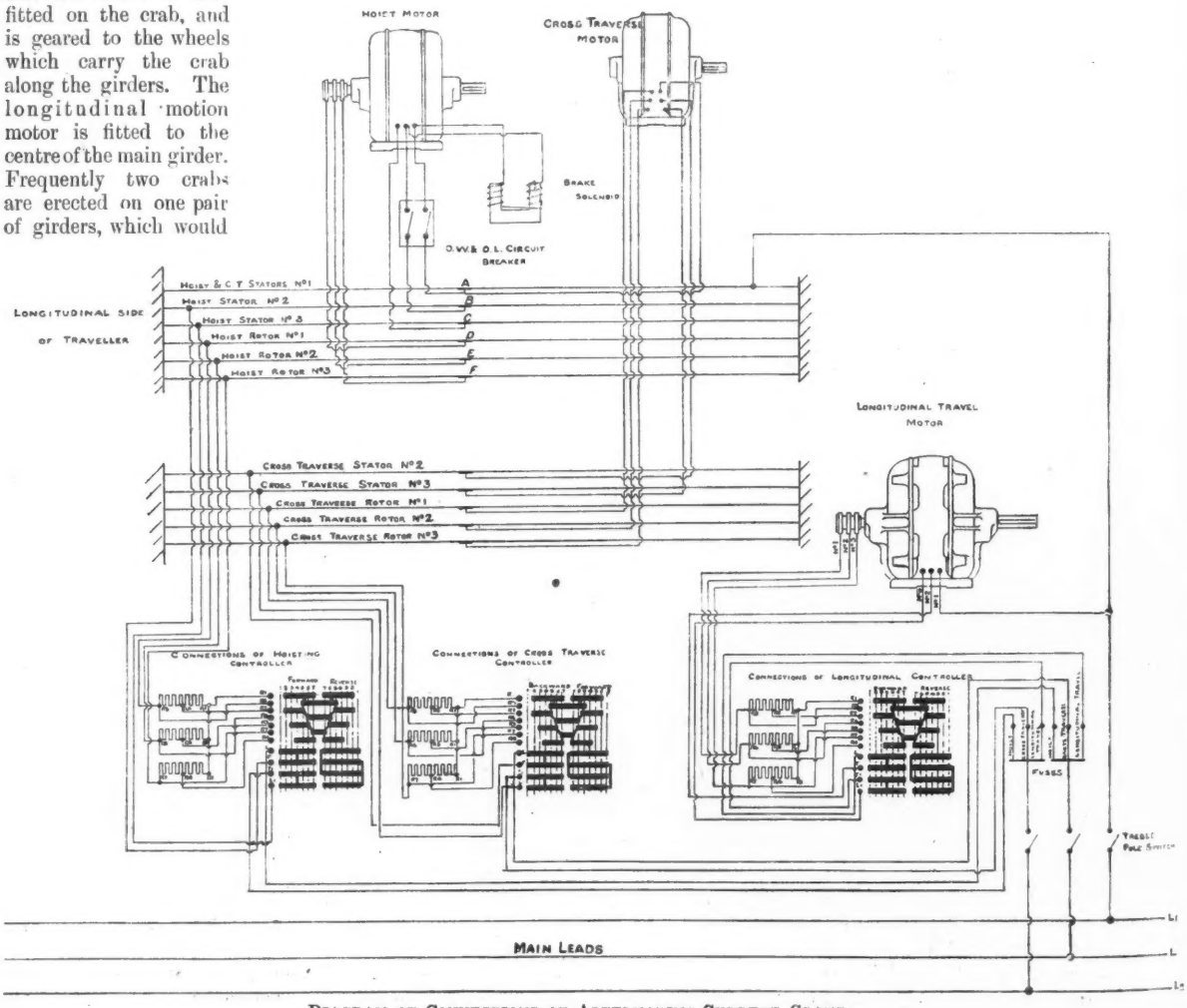

Diagram of Connections of Alternating-Current Crane.

motor leads are generally placed along the inside of both the main girders, and are of copper wire of sufficient carrying capacity. They are drawn tight on insulators which are fixed on brackets at each end of the main girders.

The current employed may be alternating or direct; in the former case it is generally three-phase. The best arrangement for three-phase motors is to have a common line for one stator cable from each motor, thus saving both copper and space.

Direct-Current Cranes.

The motors used on direct-current cranes are series wound, and are controlled by dry or liquid controllers. There are four cables from each motor, which, in the case of main hoist and cross-traverse, are connected to the motor leads as follows :—

Hoist motor on cage side.	Field.	Cross-traverse motor on L.T. side.	Field.
	,,		,,
	Armature.		Armature.
	,,		,,

The field or armature circuit is broken by an overwinding switch and brake solenoid. It is immaterial whether the solenoid and overwinding switch are placed in the armature or field circuit, as one operates in conjunction with the other. The above arrangement is shown in diagram on the opposite page for a two-motor crab, but in case an auxiliary motor is added, the motor leads would be :—

Cage side	Hoist field.	L.T. side	Auxiliary armature.
	,, ,,		,, ,,
	,, armature		Cross-traverse field.
	,, ,,		,, ,, ,,
	Auxiliary field.		,, ,, armature.
	,, ,,		,, ,, ,,

This arrangement balances the number of motor-leads on the inside of each girder.

The longitudinal traverse motor being stationary on the crane, enables the cables to be fixed along the platform of the crane, and straight to the switchboard and controllers in the driving cage. The drawings will show the connections of the main leads which supply current to the crane.

Alternating-Current Cranes.

A systematic arrangement of the motor-leads is necessary. The six motor-leads on the longitudinal side of the crane are connected to the main hoist motor. This will be seen from the drawing, but it will be noticed that the top lead is made common to both. The arrangement of the cables to the motor-leads is as follows :—

Longitudinal Side of Traveller.—Hoist and cross-traverse stator No. 1 ; hoist stator No. 2 ; hoist stator No. 3 ; hoist rotor No. 1 ; hoist rotor No. 2 ; hoist rotor No. 3.

Then having arranged that the cross-traverse stator No. 1 is connected on the same motor-lead as hoist stator No. 1, the other cables from the cross-traverse motor are arranged :— Cross-traverse stator No. 2 ; cross-traverse stator No. 3 ; cross-traverse rotor No. 1 ; cross-traverse rotor No. 2 ; cross-traverse rotor No. 3.

An overwinding switch is fitted in circuit with two phases of the stator of the hoist motor, and is automatic, so that when the hoisting block is wound too high, the stator circuit is broken, and a possible disaster averted. This action also takes place when the hoisting block is run too low.

Also there is fitted on the crab a magnetic brake solenoid, the connections being taken from the second and third stator connections of the main hoist motor, When current is on the main hoist motor this solenoid lifts the brake off, but the brake is always on when no current is on the motor. The accompanying drawing will make clear the connections for the overwinding switch and the brake solenoid and also the connections to the collectors.—S.A.K.

What is Coming in China.—As bearing upon the vast requirements of China in the near future, a German journal, quoting a Far Eastern report, says that Dr. Sun Yat Sen, chairman of the Commission of inquiry into the construction of Chinese railways, has prepared a scheme for the building of *62,000 miles of railways within ten years*, at an estimated expenditure of over £23,000,000. The money required for work during the first five years would have to be obtained abroad ; after that period, it is considered, receipts from operating lines would, together with the money that could be raised in China, enable the construction of the other lines to be proceeded with.

THE COMMERCIAL DEVELOPMENT OF ELECTRICITY SUPPLY.

III.—Publicity Methods.

Under this heading it is proposed to deal with measures for effectively placing before the general public the advantages and latest applications of electricity. There is no intention of considering methods whereby the doings of any particular individuals may be chronicled in the technical Press, or certain undertakings placed prominently before the industry generally ; such objects may be attained by big drum tactics not within the scope of this article. However sweet the uses of self-advertisement, little benefit accrues to the industry at large, and it behoves all whose connection with electricity supply is of moment to work together whole heartedly and loyally for development on broad lines.

In spite of the fact that many undertakings have been in operation for upwards of 20 years, there still exists on the part of the general public stupendous ignorance and monumental misconception of the ordinary commercial uses of electricity, and the removal of these obstructions to progress must now be seriously taken in hand. It is still the rule rather than the exception, for the average non-consumer to regard electricity as necessarily expensive and the service unreliable. The basis of such an opinion is of course sheer ignorance, which must be dispelled by real spade work.

Another point which must be driven home to laymen is that electricity in addition to not being a luxury, must be regarded as an every-day necessity on the grounds of economy, health and saving of labour, and that it can be operated more easily and safely than other systems with which, owing to long acquaintance, they are thoroughly familiar. The investing of electricity supply with the mysterious may add to the importance of junior members of staffs, but it has a serious retarding effect on progress.

Lack of expansion may also be attributed to the attitude adopted in some quarters whereby electricity supply undertakings have been regarded as the monopoly of professional men who, by strict observance of the rules of hide-bound etiquette and tradition, have preserved their escutcheon unsullied by cold-blooded commercialism. Such an academic attitude is quite appropriate in the case of the occupant of a professorial chair at a university, but in the business world the position is untenable.

In considering the elimination of the reactionary and obsolete methods which have hitherto been in vogue, it is quite possible that susceptibilities may be wounded, but it will certainly be to the ultimate advantage of the industry thoroughly to adjust various myopic and astigmatic defects previously existing in administrative vision, so that the position may be viewed in true perspective.

Throughout the business world, which does not up to the present appear to have included the electricity supply industry, strenuous efforts are devoted to obtaining and retaining the interest of the purchasing public, and the co-operation of specialists who can materially assist in achieving those objects is eagerly sought, and suitably acknowledged, as it is recognised that their efforts have a distinct influence in augmenting financial returns. As the mountain exemplified in the general public has not evinced any particularly keen inclination to approach the electrical Mahomet, it is now necessary for Mahomet to take the quickest and most direct route to the mountain.

It may be that the criticism expressed will be considered in many quarters as too caustic, and tending to exaggerate the gravity of the situation, but no useful purpose can be served by continuing to live in a fool's paradise, or, ostrich like, persuading ourselves that disaster may be averted by inserting the head in the sand of nonchalance. Disquieting symptoms may continue to be ignored for a little while, but if the circulation of the blood of the industry is to be permanently aroused from its stagnant condition, remedies, however unpalatable, must be applied for the benefit of the whole body.

Most undertakings have in the past been able to proudly draw attention to a normal annual increase in connections and revenue, and have regarded such returns with great self-satisfaction, conscientiously believing that all that was

possible had been done to develop business. Without wishing to belittle such achievements, it must, however, be conceded that for many years new customers belonged to the upper classes, to whom the expense of installation was not of serious consequence, and who would in any case use electricity as it became the vogue. Supply authorities have, therefore, been content in the knowledge that supply had been given to light the largest and wealthiest establishments within their territory, maintaining stolid indifference to the enormous possibilities of business in the lower strata of society. The lower middle, and even humbler, classes provide the bulk of the revenue for wideawake gas companies, and as electricity supply authorities have practically skimmed off the cream of the business in nearly every instance, whatever further progress is made must be largely in connection with the smaller consumer. This latter problem, however, cannot be tackled without thorough organisation, which has up to the present been non-existent. There still exists a great field for further use of current for power purposes, and in regard to heating and cooking, very little of value has been attempted.

With so much to strive for, in the face of strenuous competition, the futility of further somnolence must be apparent. Treating the prospective consumer with indifference and platitude will not meet the case, and sound publicity schemes must be established. Efforts must be made, and not of the hesitating, intermittent or spasmodic order, and the organisation of the business-getting machinery must ensure that all parts work smoothly and in unison. In the first place, it is necessary to arrest the attention of the public, and, having done so, to proceed to interest them. When the intelligent interest has been obtained, demonstration and facts in support of the claims of electricity should be given. In this sequence the activities of publicity departments should ultimately result in increase of business. Consideration of the equipment of the department whereby the foregoing object may be achieved, might be now given. The main weapon in the armoury should be advertisements, Press notices, literary matter, canvassing, and demonstration, which might be amplified or supported by other means according to special circumstances or requirements.

Advertisements.—Advertising announcements are recognised media for attracting general attention, and may take the form of posters on hoardings, Press advertisements, &c. The subject matter for these should always be drawn up in good taste, and preferably in simple and telling form. These announcements should also be devoid of irrelevant or contentious details, and if reference to competitors must be made, remarks of an offensive nature should be avoided, as abuse cannot be regarded as sound argument. Discrimination should be exercised in respect to the publication of advertisements, particularly with due regard to the season of the year, special local circumstances, and the system under which such announcements will be followed up.

Permanent notices might also be fixed on street lamp standards, public conveniences, and tramcars where suitable arrangements can conveniently be made, and as is already the practice in many districts, on prominent buildings in course of construction. Jointers' trucks and all vehicles in use by supply authorities might also be pressed into the service, and no doubt many other opportunities will occur as a result of local conditions.

Press Notices.—It should not be a matter of great difficulty to enlist the good offices of the local Press, more especially if the advertisement columns of the newspapers in question are judiciously supported. Editors often find a bright, well-written article acceptable, and it is quite possible to describe suitably the various uses of electricity in such a way as to make the article of general interest. Special local installations might be written up, more particularly where buildings are ancient or have special local interest. Reports of the opening of new business premises or public buildings present an opportunity for some mention of electricity, and an occasional paragraph describing novel inventions or improvements might also find favour.

Literature.—The contention may be raised that the industry is already burdened with a surfeit of literature. In a sense this is correct, as a large amount of printers' ink has been applied to an immense area of paper, and disposed of with no very appreciable benefit. The great mistake has been made of persistently generalising. It must be distinctly and prominently borne in mind that the greater part of the field now available for activity is composed of that section of the community to whom the question of cost is all-important, and however desirable, convenient, &c., the service of electricity is stated to be in grandiloquent pamphlets and circulars, little headway will be made unless it is possible to obtain an intelligent conception of the cost of operation. Thoroughly acquainted with the performance of older methods, the cost of which is within their means, such people cannot afford to incur unknown expense, and therefore require some more convincing information than a coloured picture and laudatory letterpress in general terms. Such literature is useful up to a point for introductory purposes, but beyond that something is required with a bite in it.

The gradation of literature also requires attention. To send to the occupant of a £25 or £30 house a pamphlet illustrated with views of rooms in a wealthy establishment replete with every evidence of luxury is absurd, and tends to sustain the deep rooted impression that electricity is intended for the service of the rich only. Similarly it would be almost equally inappropriate to send to the owner of a lordly mansion details of the equipment of a small artisan's dwelling.

Testimonials from satisfied consumers carry great weight, and the embodiment of a selection in pamphlets, &c., has a very convincing effect. In regard to power, a few illustrations and costs of local installations would be more effective than comic pictures by even eminent artists. Broadcast and indiscriminate distribution of literature is really of little avail, and amounts to extravagance. Literary matter should be carefully compiled, or judiciously selected, and the distribution should be systematic and timely.

Canvassing.—This little understood, but what might be eminently efficient, branch of the service should receive really serious attention. At present canvassing operations are not universal, and where employed are in many cases not properly organised. The canvasser is regarded generally as a tout, and little interest is taken in his welfare. As long as his returns are maintained, his qualifications and methods of obtaining business are not inquired into too closely, but should returns fall, whether from causes beyond his control or not, his services are dispensed with. The influence which a good canvassing staff can bring to bear on the fortunes of an electric supply undertaking is great, but until this fact is generally realised, and the occupation placed on a more dignified footing, the right class of men will not be attracted to the service.

Men of good education and address, with a sound practical knowledge of installation details are required, and should be regarded as responsible representatives of publicity departments. It is essential to success that members of the canvassing staffs should be accorded a good reception by prospective consumers, and they should be in a position to handle business on behalf of their department. Although the ranks of canvassers are stiffened by a leaven of qualified men at the present time, a large percentage are men totally unfitted for the work. Indifferent clerks and nonentities are at present endeavouring to cope with requirements with small success, and to the detriment of the industry.

The labours of an efficient canvassing staff should receive the systematic assistance of literary and Press work, and energy should not be wasted in disjointed operations. It is disheartening for a man to feel that he has no backing, and is expected to wait on doorsteps until applications are signed, and to go to the length of inserting his foot between the door and its frame when an attempt is made to stem the flow of his eloquence. It is radically wrong to compel him to make himself an unmitigated nuisance in order to obtain business. Misrepresentation of facts is also condoned should an application be thereby obtained, and on receipt of complaints from the subsequent consumer, apologies are offered from headquarters, pointing out that the man is "only a canvasser." This state of affairs must be remedied with the advent of the broader policy, and serious consideration given to the proper training of the canvasser.

Demonstration.—The value of efficient demonstration

should, by this time, be universally admitted and recognised by the electricity supply industry, and should be conducted either by means of periodical exhibitions or permanent showrooms. The course to be adopted would be governed, to a great extent, by local circumstances; but if possible to establish it, the showroom is more valuable. In either case, efficient attendants should be engaged, and the duplication of exhibits should be avoided. It should also be distinctly understood that pyramids of distribution boards, switches, lampholders, &c., are uninteresting, and that only useful apparatus should be shown, and that in actual operation.

In the case of a periodical exhibition, attention should be carefully given to the inclusion of all details calculated to enhance the comfort and interest of visitors. Cookery demonstrations and lectures are always an attraction, and lectures on other operations might also be included, possibly illustrated with lantern slides or moving pictures. Press announcements and advertisements should appear well in advance, and during the exhibition a great amount of information should be collected for following-up purposes.

The establishment of the permanent showroom requires even more careful consideration. The furnishing and equipment should be carried out, if possible, on distinctive lines. The interior should be of inviting appearance, and examples of the latest type of apparatus should be obtained for demonstration purposes as soon as available. The staff should be selected with care and fully qualified to deal thoroughly with the various types of humanity which will favour the showrooms with visits. Well-chosen announcements and a selection of apparatus may be shown in the window front if this exists, but the wisdom of window demonstrations is uncertain, as they often result in the attraction of street urchins, who may crowd round for hours at a time and obstruct the view of the potential consumer. The showroom should preferably be located at the headquarters of the Publicity Department and thus render the organisation as efficient as possible.

The remarks under the foregoing headings do no more than treat the subject superficially, as it is quite impossible to deal with the matter exhaustively within the scope of a short article. It is, however, probable that the case has been sufficiently stated to cause those responsible for the destinies of electricity departments to consider seriously the question of publicity organisation.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Official Balance.

Referring to "Representative's" letter *re* the above-named article, the writer feels that a few remarks in reply will not be amiss.

The airy way in which "Representative" refers to the article as likely to afford amusing reading, conclusively proves that he fails to realise what the job in question entailed. Just a damp motor requiring drying out. How very simple! Had this been as simple as it sounds the article would never have been written.

The writer cannot quite see what leads "Representative" to think that it was the writer's first experience of ship work. The writer has had 16 years of it, three of mercantile and 13 of Admiralty work, during which time he has had through his hands electric gear for 45 of H.M. ships—not a bad experience. "Representative's" suggestions *re* packing, receiving, and getting gear under cover, &c., are, no doubt, well meant, but the writer is quite alive to the need and duly takes all the precautions.

"Representative's" remark that it is not his experience that compartments are regularly water-tested with motors in place is somewhat beside the mark. The writer never suggested that it was a regular custom. The case the writer had in mind was not due to anyone's negligence, but to a misunderstanding. The writer's reference to this and the possible damage due to exposure, reckless workmen, &c., did not necessarily mean that his troubles were due to any of these causes, but were rather illustrative of the treatment which electrical gear is liable to be subjected to.

"Representative's" suggestion *re* wrapping vital parts of motors in watertight cloth would be useless to prevent damp getting into the windings. The writer's experience carries him back to when all motors and controllers were fitted in absolutely watertight cases, but the damp got in all the same.

What made the test in question unique in its difficulty was a combination of circumstances and adverse conditions never before met with, by the writer, all together on one ship.

The writer hesitates to believe that "Representative" is one of that type of critic who can always surmount other people's difficulties so easily—after they are all over.

A.M.I.E.E.

(*The writer of the article.*)

Patents and Inventions.

I have only just noticed the letter of your contributor on this subject; and I agree that, if the statement which he quotes is taken away from its context, it does become rather "startling." But the clause in my address which follows the sentence that he quotes makes it, I think, clear that what was in my mind was that legislation was required which would give the employé the right to take out the patent in his own name, subject to its not falling under any of the three disqualifications alluded to; and that it should be unlawful for the employer to use his position to compel the employé to give up his invention without any regard to its subject matter, or how he arrived at the idea.

I have not, at the moment of writing, a copy of your paper by me; I do not know whether the paragraph to which I allude appeared in it, and, therefore, enclose herewith a copy of my address, in case your contributor was writing under a misapprehension.

A. M. Taylor.

King's Heath, *November 26th*, 1912.

[The explanatory paragraph to which Mr. Taylor refers reads as follows:—

The question as to whether the employé got the idea from his employer, or whether he obtained the knowledge necessary for him to make the invention while in his employer's service, or whether his daily work was such as to necessarily provide him with the materials for the invention—all these should be left to an independent arbitrator (say, for instance, the President of the Institution of Electrical Engineers), before it is even conceded that his employer has any right to the first refusal of the employé's invention.

This paragraph did not appear in our abstract.—EDS. E.R.]

Electricity Supply Publicity.

Much dipping of the pen has been indulged in during the last year by people anxious to show how electric supply undertakings ought to be run, betraying at the same time, much ignorance of essential conditions. The writer of the article in yours of the 22nd inst., sheep like, trots out a little cheap sarcasm at the Joint Publicity Committee. This Committee, established under the able chairmanship of Mr. H. B. Renwick, drew up a complete scheme of organisation, but difficulties prevented more than one or two sections being started. The production of pamphlets, however, has been on a large scale, and from my actual experience of the use of such, has brought considerable increase of business.

The other sections of the scheme require liberal subscriptions, not only from supply authorities, but from manufacturers. The manufacturers have not yet realised their responsibilities.

The municipal electric supply authorities in London are prevented from assisting by Government auditors, leaving only London companies and provincial municipal authorities to provide the money.

As in any general scheme of advertising the London authorities would benefit without sharing in the expense, a

little consideration should show that the efforts of the Joint Publicity Committee to formulate and get in working the complete scheme is not easy.

It will be time enough to criticise the Committee when, having first provided them with sufficient funds, they fail to give value for the money subscribed. At the present time, the Committee are expected to spend large sums on advertising, and to do many things that can only be carried out when a proper technical staff is at command, but every critic coolly ignores the question of how this is to be done without money.

The gas interests have been driven to combine by realisation that they are fighting for existence, but the electrical supply people, with business increasing all the time, have not the same incentive to combination.

Alex. C. Cramb,
Manager.

Electricity Works, Croydon.
November 26th, 1912.

The Institution of Electrical Engineers.

I have been reading in your "Correspondence" columns lately about the wages paid to submen. We know that some of the richest companies in the United Kingdom pay their submen something scandalous. For instance, in a sub-station belonging to a certain traction company I know some "engineers-in-charge" (save the mark!) who are paid the stupendous salary of five shillings a week, yet all the responsibility of the station is on their shoulders.

Your correspondent, "Booster," in his article, November 29th, says: "I do not say that we should be paid large salaries, but what I do say is, that we should at least get a tradesman's wages. . . ." I do not agree with "Booster" there; I say that a sub-station attendant should get a decent salary. Remember his education, training and apprenticeship. Is the electrical business not a profession of its own? If so, why not keep it above the level of the ordinary tradesman? Yet we have submen who are expected to live, clothe, study and keep themselves respectable on 5s. per week. I suppose in a few more years the yard men or the general labourers about the stations will be expected to "take charge" in their spare time.

Why not form an association at once, and put this sweating down for good? Practically every business has an organisation or society, except the electrical business. No doubt we have an Institution of Electrical Engineers, but what good is that to the sub-station attendant?

For goodness' sake, let an Association be started at once. I, personally, would be only too glad to act in any way that would help to form one.

Motor-Generator.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The G.E.C. "Just-for-Two" Cooker.

The latest type of cooker placed on the market by the GENERAL ELECTRIC CO., LTD., is appropriately named the "Just-for-Two." This appliance boils, broils, fries and toasts; it cooks above and below the heating element, and will make two slices of toast above

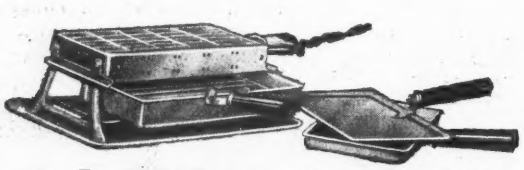

FIG. 1.—G.E.C. "JUST-FOR-TWO" COOKER.

and two slices below at the same time. Should more heat be required above, a shallow dish, which is provided for the purpose, can be inserted into the grooves underneath, its polished surface reflecting the heat upwards. Similarly, the heat can be thrown downwards. A deep pan is provided for frying, grilling, &c. The heating wires are protected by a guard. The dimensions of the cooker are 8½ × 4½ × 3½ in.; it consumes only 600 watts. The parts are nickel-plated, and are supplied complete with flexible and adapter.

Feed Regulator for Coal-Cutter.

THE DIAMOND COAL-CUTTER CO., of Stannard Works, Wakefield, have applied to their machines the "Crossland" patent automatic feed regulator, which controls the forward travel of the cutter. The arrangement is shown in fig. 2, where A is a solenoid in series with the armature of the motor, which, when a predetermined current is exceeded, draws in the plunger C against the weight B and auxiliary spring D; this action lifts the pawl attached to E, and prevents the feed from taking place until the current falls below the limiting value, when the pawl is released. Overloads often occur through extra hard material being met with, the

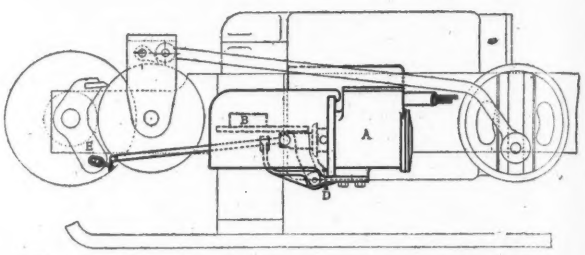

FIG. 2.—CROSSLAND REGULATOR ON DIAMOND COAL-CUTTER.

picks becoming blunt, or the machine being fed too rapidly, and the use of the automatic device prevents damage to the machine on such occasions, while allowing the cutter to advance the moment the difficulty is overcome. The device is applicable to both D.C. and A.C. machines, and is said to have given very satisfactory results in practice, the gate-end fuses, which formerly blew frequently during every shift, requiring renewal only at intervals of weeks, and armature breakdowns being reduced 70 per cent.

The "Magnet" Iron in a Xmas Box.

In order to make the "Magnet" electric iron appeal more definitely to those who wish to give a Christmas or New Year gift, the GENERAL ELECTRIC CO., LTD., have prepared a compact electric ironing set packed in a dainty coloured box. The set includes a "Magnet" iron, length of flexible wire, electric lampholder, adapter plug and a special cleaner and polisher by the use of which

FIG. 3.—THE "MAGNET" IRON IN BOX.

the high polish of nickel plate may be kept unimpaired. These are packed in a triangular-shaped box, the apex of which is flattened. The box opens diagonally, and the cover is secured by a nickel-plated snap clasp. It is a box worth keeping, the kind that might serve a variety of purposes in a household if not required to hold the iron; and it would look well in a Christmas window and draw inquiries.

Electric Tea.

THE AFTERNOON TEA CABINET CO., of Birkbeck Chambers, High Holborn, have devised a neat cabinet, fitted with a kettle on an electric heater, six cups and saucers, spoons, and all other necessaries, which is lent by the company to subscribers, and is kept supplied by them with tea, sugar, milk, and biscuits at a moderate charge. In the bottom of the cabinet is a receptacle containing a clothes brush, hair brush and comb, nail brush, hat brush, a set of boot brushes, polish, and polishing cloth.

B.T.H. Table Grill.

THE BRITISH THOMSON-HOUSTON CO., LTD., Rugby, have recently placed on the market a neat nickelled table stove, under the name of the B.T.H. Radiant Electric Table Grill, which can be used to grill, broil, toast, stew, or fry, and is especially suitable for the breakfast table. The cost of operation is about 2½d. an hour, with energy at 4d. per unit, the consumption being 600 watts.

The heating element is contained in the upper portion of the stove, which is attached to the stand by a divisible hinge, and can be lifted to place the food underneath it on the grid. The heater consists of a spiral of calorite wire, supported on heat-resisting insulators and protected by a nickel-plated screen of expanded

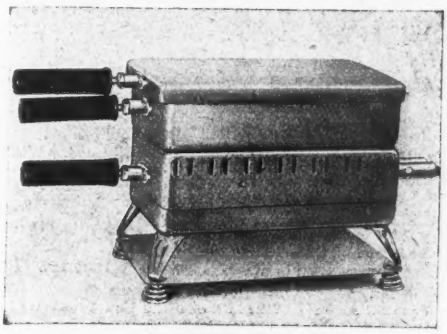

Fig. 4.—B.T.H. Radiant Electric Grill.

metal. The calorite wire, we understand, melts at 2,800° F., and resists oxidation up to a very high temperature. There are two pans with the grill, for frying and boiling, the former serving also as a lid for the latter. The heater can be immersed in water for cleansing without injury.

B.T.H. Luminous Radiators.

In addition to the wide range of non-luminous heaters made by the British Thomson-Houston Co., Ltd., the company are now supplying from Mazda House, 77, Upper Thames Street, lamp radiators in a number of patterns. In all these radiators the framework is of hand-beaten art metal, with, in some cases, the additional

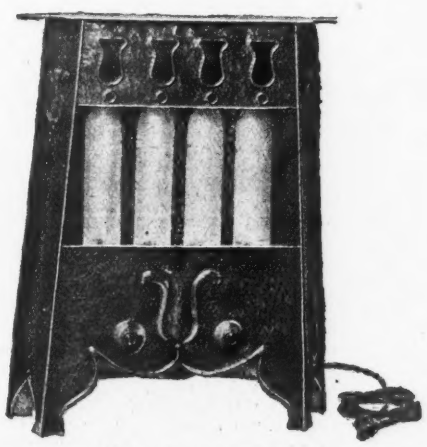

Fig. 5.—B.T.H. Luminous Radiator.

embellishment of pottery and enamel ornaments. The radiators are supplied completely wired, with B.T.H.-Edison radiator lamps, holders and flexible cord. The company have issued a folder which illustrates and gives prices of six patterns of luminous radiators and lamps.

New Microscopical Lamp.

Prof. E. E. Roberts, of Cardiff, recently designed a lamp especially adapted to microscopic examinations, of which the General Electric Co., Ltd., has undertaken the manufacture. The brass

Fig. 6.—Microscopical Lamp.

foot is heavily weighted and covered with baize underneath; the upright portion is brass tubing, bent to accommodate the lamp itself, and at the top is a knuckle joint by which the lamp can be adjusted to any required angle. The parabolic shade is of nickel-plated metal. The source of light is an Osram lamp, frosted below. The appearance of the lamp is shown in the accompanying illustration, fig. 6.

The B.T.H. Tungstolier.

Following on the lines of the "Mazdalier," which we recently illustrated, the British Thomson-Houston Co., Ltd., has brought out a fitting styled the "Tungstolier," which is similarly supplied packed in a carton, and is ready wired with holders and galleries attached, so that it can be quickly built up into a complete fitting; it may have two, three, four or six arms, and there are five designs of bottom shell, with canopies to suit, and two bodies. With these parts a great variety of fittings can be built up, while the stock comprises only 18 different parts, all of which are standardised. The "Tungstolier" is a more handsome and substantial type than the "Mazdalier," which is intended to cover the purely utilitarian field.

LEGAL.

Hull Corporation *v.* Stickney.

On November 28th a case, in which great public interest was centered, was heard at Hull, where Mr. Walter Herbert Stickney, surveyor and valuer, was charged with contravening the by-laws of the Corporation by alighting from the driver's end of a tramcar at a terminus. Mr. Platts prosecuted on behalf of the Corporation, and Mr. H. S. Cautley, M.P., barrister, defended.

It was alleged that the defendant had contravened the by-law stipulating that "every passenger shall enter or mount upon, or depart from, or get off a car by the hindermost, or conductor's platform, and not otherwise." Against this it was urged that the by-law was contrary to the Board of Trade Regulations, which states that "the entrance to, and exit from, the carriage shall be from the hindermost—or conductor's platform—except at a terminus, when the carriages are stationary." The defendant was fined 15s. (in absence) at the Court in July last, and, being convinced that the by-law could not be legally upheld, he resolved to have a test case.

Mr. McCombe, the tramway manager, replying to the Stipendiary, said the hindermost end for passengers getting on was the end nearest Beverley, and the hindermost end for getting off was the end nearest Hull. He confessed that it depended on the interpretation of the passenger.

Several drivers and conductors gave evidence to the effect that Mr. Stickney committed the alleged offence of getting off at the wrong end of the car nine times. On one occasion the driver prevented him by running the car into the depôt.

Mr. Carthey held that the Board of Trade regulations superseded the Corporation by-laws, and that if there was any conflict between them the Board of Trade regulations must prevail.

Mr. Platts pointed out that the Corporation by-laws were in existence before those of the Board of Trade, and he argued that the Board of Trade by-law referred to the cars in transit, while the Corporation by-law regulated the entering and exit of passengers at the termini.

The Stipendiary (Mr. J. G. Hay Halkett) said he had decided to dismiss the summonses. He was of opinion that the Corporation by-law was in conflict with the Board of Trade by-law which ought to prevail. It should be clearly understood that this was an entirely new point, and was not raised in that Court when the defendant was last before him. On the arguments he had heard he was of opinion that the by-law was not good. The uncertainty arose the moment a car drew up at the terminus, for who could decide the psychological moment at which a driver's platform became a conductor's platform? After some discussion, he allowed the defendant 10 guineas costs.

Price *v.* Sylverlyte (1909), Ltd.

In the King's Bench Division on November 27th, an action was heard before Mr. Justice Avery and a common jury, brought by Mr. Sidney Leopold Price, trading as the Electric Battery Co., of High Holborn, against Sylverlyte (1909), Ltd., of Sise Lane, Queen Victoria Street, E.C. Plaintiff claimed for the price of goods sold by him to the defendant company, or, in the alternative, for damages for breach of five contracts to purchase from the plaintiff some 600 electrical accumulators. Of that quantity, something less than half were accepted and paid for by the defendants, who had refused to accept delivery of the balance. Defendants denied that they made any of the contracts, and said that it was a term of the contract that they should only accept delivery of the goods when they required them. Further, in regard to the second contract, that was made in substitution for the first contract.

Mr. T. Hollis Walker, K.C., and Mr. Woodgate appeared for the plaintiff, and Mr. R. J. Willis for the defendant.

Mr. Walker, opening the case, said Mr. Price, the plaintiff, was a maker of electrical accumulators and other similar motor accessories. The defendant company was formed in 1909, and were successors, he believed, to a company of the same name, who carried

on the same kind of business. They were motor-lamp makers and carried on their business in Great Portland Street, but had a registered office in Sise Lane, Queen Victoria Street. The action arose out of several orders to supply electric accumulators of various sizes. In all, 600 accumulators were ordered by the defendant company; 285 of them had been taken, but 315 defendants had not taken. The action, as originally framed, had a two-fold purpose—first, to recover the balance of the purchase price of the 285 accumulators that had been taken, but not wholly paid for; and, secondly, to recover damages in respect of the fact that the remaining 315 had not been taken at all. But as regards the 285, the jury would not be troubled with them, because the claim in respect of them was admitted, and all issues on that point were cleared out of the action. In regard to the 315 accumulators, there were five orders relating to them. Although, explained Counsel, in the first instance each of the orders were verbally negotiated between plaintiff or his manager, Mr. Gregory, and the defendant company, it was not necessary to go into that, because in every instance the order was reduced into writing. The first order was on October 28th, 1909, for 250 accumulators at 13s. 6d. each, of which only 61 had been taken; the second order was on November 2nd, 1909, for 200 accumulators at £3 7s. each, of which 116 had been taken; the third order was on May 3rd, 1910, for 50 accumulators at £4 10s., of which 46 were taken; the fourth order was on September, 1910, for 50 at £1 17s. each, of which 39 were taken; the fifth order was on December, 1910, for 50 accummulators at £2 16s. 6d. each, of which 23 only were taken. Plaintiff's case was that delivery should have been taken within a reasonable time, but the precise dates of delivery and quantities, of course, depended on one's requirements. What was said here, was that long periods had elapsed, and that defendants had exceeded the bounds of all reason; and had allowed more than a reasonable time to elapse before taking delivery. In the manufacture of these accumulators, there were certain electric battery cells which required a particular amount of adjustment. What the plaintiff did as soon as he got the order was to at once set about obtaining the materials with which these accumulators would ultimately be made He had the cells prepared, and the only thing he did not do was to have the various parts assembled, so as to make the complete accumulator. The reason he did not do that was because it was harmful to set up an accumulator, and then leave it for months before it was going to be used. There was also the question of the position of the terminals which the defendant company was in the habit of giving instructions about. These materials were not for ordinary accumulators, except in the case of one contract. They were all of a special kind, and required teak boxes of a special size and make. A special kind of cell was also required, with the result that if they were not taken by the defendant company, they were practically lying useless in the plaintiff's hands.

On November 28th, when the case was called on, Mr. Walker said he had to ask his Lordship to give judgment for the plaintiff by consent for £200 and costs. The undelivered goods would remain the property of the plaintiff, that was to the exclusion of the balance of goods sold. In regard to the outstanding balance of the goods actually delivered, there was £30 due which had been paid into Court. He asked that that amount might be paid out. This was agreed to, the verdict of the jury being taken by consent, in accordance with the above terms.

The Telephone Arbitration.

(*Continued from page* 868.)

Sir A. Cripps, during the course of further arguments, said that no doubt the Postmaster-General had discovered some defects in the armour of the company. The hearing of the case had extended over 63 days and involved a claim of 20 millions, so that it would have been extraordinary if some defects had not been found. At the proper time, however, he would be prepared to admit the extent of the defects and remedy them. Continuing, he said the balance-sheet of the company taken at the time of its being taken over showed a capital cost of £15,677,810. From that he agreed that there should be deducted £1,816,988 expended on patents and goodwill, and therefore not attributable to the cost of the plant. That deduction left £13,860,822 as the capital cost in the balance-sheet, leaving out of account the large sums which had been spent out of revenue and which were properly attributable to capital expenditure. The Solicitor-General had contended that the charges for depreciation, amounting to somewhere about five millions, ought to be deducted from that amount, but he thought that was a fallacious argument. There could be no proper deduction from that capital cost shown on the balance-sheet, on account of depreciation, because there really was no depreciation. During every year of the existence of the plant, money was spent on renewals and repairs sufficient to keep the value of the plant up to its original cost. That was, he said, a system of accounting which prevailed in practically every railway in the country. It was a system which was criticised by Americans as not showing the true value of the assets. Unquestionably, however, it was the practice in this country. To the 13 millions odd shown in the balance-sheet of the company as capital cost there should be added over £2,300,000, which had actually been spent out of revenue and ought to have been, but was not charged to capital. That figure shown in the balance-sheet the Solicitor-General had chosen as a check upon the claim of the company. It could not be properly employed as a check, because the cost that did happen and the cost that would happen were not alike. In the balance-sheet there was shown only expenditure necessary to keep the value of the plant alone up to its original cost. The claim of the company, exclusive of land and buildings, amounted roughly to 18½ millions, and the Solicitor-General sought to compare the £13,000,000 odd of the balance with it, but it was obvious that there were included many things that could not be included in a balance-sheet. The claim of 18½ millions was made upon the basis of the cost of reconstruction of the system on the usual tramway terms. In that, of course, there were included interest on capital during construction, contractors' profits, and other items, which in the aggregate amounted to about three millions, so that even the check proposed by the Solicitor-General went to strengthen the case of the company.

When the Court resumed, after the adjournment, Sir A. Cripps said that the parties had been able to agree on several very important items of the claim. It had been agreed that the materials, less wastage, should stand at £6,963,383. With regard to freight, cartage, &c., they had also arrived at an agreed figure, and these with the sums for materials, less wastage, now amounted to a total of £10,239,345, as against £10,313,000 originally claimed. Continuing, the learned counsel suggested that if the Court would allow the Attorney-General and himself to discuss privately with the Commissioners certain matters, the length of the subsequent proceedings would in all probability be curtailed.

Mr. Justice A. T. Lawrence said the Court would endeavour to make the arrangement suggested.

Sir Alfred Cripps, in continuing his argument on behalf of the company, dealt with the cost to the company for supervision, which he submitted they were entitled to claim for.

Sir James Woodhouse observed that the cost of supervision estimated by the company from their own experience, included a sum for supervision on maintenance as well as supervision during construction, and that the contention of the Post Office was that the cost of supervision of maintenance and repairs was much higher than of construction.

Sir Alfred pointed out that the company based their claim upon charges accruing in a composite year, arrived at by averaging the expenditure of a number of years over their own system. The Post Office, on the other hand, based their valuation upon an estimate for reconstruction of the whole system in a given time.

Sir James Woodhouse said the contention of the Post Office was that the cost of supervision during maintenance and repairs was three times as great relatively to the cost of labour during construction.

Sir Alfred Cripps said if the inference drawn from the fact that the cost of supervision to labour in some particular case of maintenance was greater than in construction, it was a nonsequetor. His information was that taken over all, one thing equalled another, and that therefore the company were justified in including maintenance as well as construction in making up the expenditure in the composite year on which their claim was based.

(*To be continued.*)

Gery *v.* Day Motor Co.

In the High Courts, on Monday, the Official Referee, Mr. Muir Mackenzie, gave judgment in the action of Gery *v.* Day, in which Mr. A. R. Orton Gery, of Royston Court, Ferryside, Carmarthen, sued the Day Motor Co., of Putney, for damages for an alleged breach of contract for supplying him with an electrical generating plant for the purpose of lighting his house with electricity. It was contended by the plaintiff that the plant in question was not up to specification, and was not in accordance with the contract. He submitted that he was therefore entitled to reject it, and he claimed a sum of £52 8s., the amount paid on the plant, and a further sum of £47 6s., moneys, he said, he had spent in consequence of the defective condition of the plant. Defendants, on the other hand, denied that the plant was defective and counter-claimed for a balance due on the contract price.

In giving judgment, the Official Referee outlined the facts of the case and said that among the defences put in was one that the plant was not sold to the plaintiff but to a Mr. Brown, an electrical engineer, and that plaintiff could not maintain an action. On this point he found that as between Mr. Brown and plaintiff there were relations of principal and agent, and that plaintiff was the buyer through Mr. Brown. Continuing, the Referee said he was of opinion that the plaintiff had failed to prove that the generating plant was defective, or that it did not comply with the specification. It was supplied for lighting the house through the batteries. Defendants would, therefore, be entitled to judgment on the claim and on the counterclaim. In respect to the latter he awarded them a sum of £32 5s. 2d. The costs would be defendants' except as to one or two small issues on which they had failed. He gave liberty to either party to apply.

The Bradford Strike Prosecution.

At the Bradford City Police Court, on Thursday last week, the Stipendiary Magistrate (Mr. H. W. W. Wilberforce) delivered judgment in the case brought by Arthur Arrowsmith, of Leeds, against Lionel Barker and Atkinson Pinder, of Bradford, for persistently following him from place to place without legal authority in connnection with the electricians' dispute at Bradford.

Mr. Alex. Neill, who appeared to prosecute, said that since the case was last before the Bench, electric cables had been cut at places where men who were not on strike were working. They could not find out who did the damage, but it had been done, and there could be nobody else capable of doing it except workmen employed in the same trade. He might say that the cables had been cut in a very expert and skilful manner.

The STIPENDIARY MAGISTRATE said he could not take any action on that matter. He reviewed the evidence which had been adduced at the previous hearing (see ELECTRICAL REVIEW, page 830, November 22nd), and said that one factor which had to be borne in mind was that the witness Horsfall, who had been working with Arrowsmith previous to November 25th, on which day the persistent following took place, appeared to be so frightened with his experience that evening that he had left work the following day. That seemed to him to prove that the persistent following and argument was not done in an innocent manner. There was no evidence that the defendants only took a silent part in the discussions on the tramcar. The handbills which had been distributed, though couched in rather unhappy terms, did not contain anything of a bad character. During the hearing it had been suggested that the action was an act of revenge on the part of the police for some complaint which had been made against a constable. There was not the slightest foundation for that suggestion, and he was sorry that the defendants' solicitor had brought such a foolish insinuation into the case. The defendants' solicitor contended that his clients were protected by a section of the Trades Disputes Act, but he (the Stipendiary Magistrate) would direct attention to another statute—the Conspiracy and Protection of Property Act, 1875, a sub-Section of which dealt with the persistent following of a person from place to place. To his mind it was perfectly clear that the section in the Trades Disputes Act which had previously been quoted, did not apply in this case. The words which had been used were innocent in their way, but the surroundings in which they were made—the booing and hooting of the crowd, the rush to the tramcar and so on—gave to them a meaning which otherwise they would have lacked. He was further strengthened in the conclusion which he had come to by the action which had been taken by the witness Horsfall. In his judgment the prosecution had proved the charge, and he would bind the defendants over to keep the peace for six months in the sum of £10 each and each would be ordered to pay three guineas costs or 14 days' imprisonment

KELLY *v.* A.E.G ELECTRICAL CO., LTD.

LAST week, at the Green Street Sessions, Dublin, before the Recorder, Edward Kelly, of 16, Amiens Street, sued the A.E.G. Electrical Co., Manchester, for £15 11s., for work and labour done at the request of the defendants.

It appeared from the evidence that the plaintiff, who was acting as Dublin agent for the defendants, in respect of this transaction, ordered an engine for a customer, and was to be paid by commission. The engine was sent forward, but the plaintiff alleged that the pulley was not as ordered. At his own expense, the plaintiff had the pulley altered at a cost of £15 11s. The defendant when applied to for payment, said they supplied the machine as ordered.

The RECORDER, in giving judgment, said the defendant company put forward a defence which was denied, and proved to be false by their own letter. He had no doubt the machine had to be refitted in Dublin, and he would give a decree for £8.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"DOUBTFUL" writes:—"The writer is not quite clear as to the correct interpretation of Sec. 10 of Electric Lighting Act, 1909. Please be good enough to state:—(1) Whether the maximum revision referred to applies to a private lighting company supplying for public consumption. (2) (*a*) Whether the limit of five years refers to the length of time between any revision in prices when once given, or (*b*) whether five years' notice of an increase in price is necessary. Thanking you in anticipation."

*** There is no reason to be surprised at "Doubtful" being confused by Sec. 10 of the Act of 1909, because it is one of those provisions which involve legislation by reference.

As to (1), if "Doubtful" means by a "private company" a company which is supplying electricity otherwise than in accordance with a provisional order or special Act, such a body is under no control whatever in the matter of charges. Nor does it matter that the supply is given to a public body. Assuming that it (the private company) is supplying in accordance with a provisional order, it is clear that the provisions of the section apply to "supply to a corporation" as well as to "supply to an individual."

As to question (2), it is fairly plain, having regard to the words of the Act, that no notice of revision need be given.

South Africa.—At a recent meeting of the Stellenbosch (Cape Province) Council, it was decided to give notice that it was the intention of the Council to borrow £10,000 for the purpose of establishing an electric lighting and power scheme, and that the plans and specifications as prepared by Prof. Bohle be submitted to the Administrator for consideration in terms of the Electric Power Ordinance, 1911.

A special meeting of the Maitland Municipal Council has been called to discuss the question of electric lighting. The energy may be obtained from the Cape Town Council.

REVIEWS.

The Mathematical Theory of Electricity and Magnetism. By J. H. JONES, M.A., F.R.S. Second Edition. London: Cambridge University Press. Price 15s. net.

This book is for the mathematical physicist. It gives the mathematical theory of a well-defined range of electromagnetism, together with the mathematical analysis required for its treatment. The range covered is approximately that of Maxwell's original treatise, but the author claims—and justly—that while Maxwell's treatise was written for the fully-equipped mathematician, the present work is more useful to the student and to the physicist of limited mathematical attainments.

In the present edition the chapter on the electromagnetic theory of light has been largely rewritten and considerably amplified, and two new chapters appear on the Motion of Electrons and on the General Equations of the Electromagnetic Field. These last chapters—in which the author does not aim at completeness of treatment—are for the purpose of giving an introduction to the more recent developments of the subject.

A number of examples, taken mainly from the usual Cambridge examination papers, are inserted. These provide problems for the mathematical student, and they also form a sort of compendium of results for the physicist, showing what types of problem admit of exact mathematical solution.

The work opens with an introduction on the three divisions of electromagnetism, and is thereafter divided into three main sections:—(*a*) Electrostatics and current electricity; (*b*) magnetism; and (*c*) electromagnetism. It is splendidly printed and bound, and will form a valuable addition to the library of the mathematically-inclined engineer.

Fuel Economy. By WM. H. BOOTH. London: S. Rentell and Co., Ltd. Price 1s. net.

An idea of how "Fuel Economy" came into being, and of what one is likely to find therein, can be obtained from the Dedication—in itself a novelty in a technical work—which Mr. Booth has placed on his title page, this being to the effect that "this small book is dedicated to my 1909-10 class of stokers at the Borough Road Polytechnic, in recognition of the attention and patience with which they supported my efforts as a lecturer." The work is certainly highly practical, and is likely to be found of value by central station engineers and electricians in charge of steam-raising plant. The lectures were given under the auspices of the London Coal Smoke Abatement Society, and, as reproduced in the present volume, should certainly further the excellen objects of that society, in that there can be no real economy of fuel where excessive smoke is produced as a result of its imperfect combustion. The volume is arranged with a view to affording an insight into the elementary chemistry of the combustion of fuels, and the means whereby the principles of chemistry can be, or are, applied to secure that combustion shall be carried on smokelessly and economically.

The author begins his task by describing the various scientific methods now used for ascertaining the calorific value of fuels, methods which have replaced the crude old way of taking a known quantity of coal and burning it under a boiler in order to show how much water it would evaporate. Two well-known types in common use—the Berthelot-Mahler calorimeter and Thompson's calorimeter—are described. The latter is probably the simpler, consisting of a metallic bell, in which the fuel is burnt in a measured quantity of water, the rise in temperature of which gives a measure of the heat value of the fuel. Natural draught and forced draught are dealt with, as well as the leakage of air through brickwork, a matter of considerable importance where perfect combustion is aimed at. Mr. Booth describes many of the various types of boilers on the market, and the best methods of working these, dealing particularly with forced draught. Somewhat out of its correct genealogical order is a section devoted to "How to light a fire." Surely it would have been better to have commenced a work on fuel economy with this, rather than to insert it one-third of the way through the book.

The use of the steam jet as an aid to fuel economy is touched upon, but in view of recent experiments in this direction, one can hardly agree with the statement that "the steam jet requires a lot of steam, so that where possible we like to avoid it." The recently introduced Caley-Robinson furnace is probably too new to have been included by Mr. Booth, but this is an example of the economical use of the steam jet, and for the rest it is quite in accordance with the author's statement that "the steam jet properly applied to a fire draught will often help to avoid smoke, and, further, it will often prove economical by enabling very inferior fuel to be used that would otherwise be useless." The author has a good opinion of the Lancashire boiler, holding that this, with a good draught, careful firing, and sufficient air admission, can be made to burn its fuel without smoke, but only so long as it has no cross tubes in the furnace, and has the customary air admission. Judging by the smoke in manufacturing places where Lancashire boilers are used, we must conclude that the author's cross-tube *bête noir* is in full vigour, assuming, of course, that the draught is requisite.

The use of the pyrometer is certainly helpful with a view to getting the best out of a furnace, hence Mr. Booth is wise in including a reference to these instruments, describing particularly the Féry electrical radiation instrument, which is very suitable for furnace work. He rightly holds that "in a few years' time we shall see more of these instruments used." The development of mechanical stokers is interestingly traced by the author, who then passes on to a consideration of fuel economisers and the question of superheat. The latter, he considers, is connected with the smoke question, because when superheaters are added to boilers, they may assist or prevent smoke by reducing the load on overworked boilers, or again, they may produce smoke if the load on the boilers, being reduced, compels such closing of the chimney damper as to spoil the draught over the fire.

The final portion of the book is devoted to a simple consideration of the physical units and chemistry necessary for a clear understanding of the subject of fuel economy, though here again this portion seems out of its correct order in the scheme of the book.—G. S. S.

BUSINESS NOTES.

Philippine Islands.—An American official publication states that "the contract for construction of an electric light and ice plant for Lucena, Tayabas, Philippine Islands, has been awarded by the Lucena Electric Light, Ice and Water Co. to E. C. McCullough and Co. at $30,000, the plant to be built upon latest improved methods, the first to be used in the Philippines in that class of construction. Besides furnishing electric lights and ice for the city, the Lucena Co. will supply the municipality with distilled water. The plant will use crude oil instead of coal, and Crocker-Wheeler generators will be installed. The construction of the electric light plant will begin at an early date, concrete poles will be used, the cross-arms will be of steel, as well as the pins, this being a new invention that will be used for the first time in the Philippine Islands. The line will include approximately 40 miles of wire to be strung throughout the town of Lucena, and 100 Philips 60-watt lamps will be installed to light the streets. The company has contracts for 3,000 incandescent lights to be installed in private houses and Government buildings, which will be increased from time to time.

Book Notices.—*The "Mechanical World" Pocket Diary* and *Electrical Pocket Diary for* 1913. Manchester: Emmott and Co., Ltd. Price 6d. each.—These old friends, growing more corpulent year by year, have been put through the usual revision; in the former, the sections on gas and oil engines and suction-gas producers have been rewritten, and a variety of alterations made, including the addition of a number of new sections; in the latter, the sections on dynamos and motors and measuring instruments have been rewritten, and new sections have been introduced dealing with magnetism, load and power factors, motor applications and control, &c. They are wonderful productions at the price.

The Indicator Handbook, Part II. By C. N. Pickworth. Manchester: Emmott & Co. Price 3s. net.—This well-known treatise is now in its fifth edition, and has been reset, besides undergoing extensive revision and enlargement. It has long occupied a place in the foremost rank of specialist handbooks, and needs no commendation at our hands.

Beginner's Guide to the Microscope. By C. E. Heath, F.R.M.S. London: Percival Marshall & Co. Price 1s. net.—The microscope is so extensively used in engineering nowadays, and is becoming so valuable an instrument in many applications, that no apology is needed for drawing attention to this admirable little introduction to one of the most fascinating pursuits imaginable. A reader who masters the instructions here given, with practice will readily acquire the skill that will enable him to use the microscope to good purpose in technical investigations.

We have received from the P. & O. Steam Navigation Co. a copy of a very interesting and useful pocket diary and almanac for 1913. Full information relating to the company's agents abroad, pleasure cruises and other services, mail dates to India, China and Australia, &c., is given in handy form, and a number of maps indicating lines of communication are published, followed by daily diary and memoranda space for 1913.

"Common Battery Telephony Simplified." By Walter Atkins. Price 3s. net. "Electrical Engineering for Mechanical and Mining Engineers." By H. J. S. Heather. Price 9s. net. London: *Electrician* Printing and Publishing Co., Ltd.

"Radioactive Substances and their Radiations." By E. Rutherford. Cambridge: University Press.

"*Journal* of the Institution of Electrical Engineers." No. 216, Vol. 49. Index to Vol. 49. London: E. & F. N. Spon, Ltd.—The issue for November, 1912, contains the following: Report of the Council for 1911-12; Annual Accounts; Condensers for Metal-Filament Lamps, by A. W. Ashton; Tariffs for Electrical Energy, by W. W. Lackie; Yellow Flame Arcs, by M. Solomon; Power Generation and Distribution in the Clyde Valley Co.'s Area, by D. A. Starr; Homopolar Generators, by E. W. Moss and J. Mould; Overhead Line Conductors, by E. V. Pannell; Auxiliary Machinery on Steamships, by E. T. Caparn; High-Voltage Testing Transformers, by R. G. Parrott; Wireless Telegraphy Transmitters, by P. R. Coursey and G. G. Dawson; The Transmission of Electrical Energy by Direct Current on the Series System, by J. S. Highfield.

"*Transactions* of the North-East Coast Institution of Engineers and Shipbuilders." Vol. XXIX, Part 1. November, 1912. Newcastle-on-Tyne: The Institution. Price 5s.

"*Journal* of the Western Society of Engineers." Vol. XVII, No. 8. October, 1912. Chicago: The Society. Price 50 cents.

"Tait's Electrical Directory of Australia and New Zealand." 1912-13. Melbourne: *The Mining and Engineering Review.*

"Physikalische Grundlagen der Elektrotechnik." By Dr. F. F. Martens. Brunswick: Vieweg & Sohn. Price M. 8.

"Text-Book of Applied Mechanics." Vol. I. By Andrew Jamieson. 1912. London: Charles Griffin & Co., Ltd. Price 6s. net.

"*Journal* of the South African Institution of Engineers." Vol. XI, No. 4. November, 1912. Johannesburg: The Institution. Price 2s.

"Wireless Telegraphy Simply Explained." By H. T. Davidge. London: Percival Marshall & Co. Price 6d. net.

"*Journal* of the Franklin Institute." Vol. CLXXIV, No. 5. November, 1912. Philadelphia: The Institute. Price 50 cents.

"Osrams" on the Jungfrau. — Jungfraujoch, Switzerland, the highest railway station in the world (3,475 metres) has recently been equipped with Osram drawn-wire lamps. The authorities of the Jungfrau Railway, in Eigergletscher, Switzerland, have also equipped several trains (Nos. 8-10) with Osram lamps, as well as their station Eismeer.

Write-Ups.—The following editorial notes have just appeared in our American contemporary *Power*:—

"For the benefit of the reader and advertiser alike we take this occasion to declare our position with regard to publicity matter. By the latter is meant anything emanating from manufacturers, whether news, descriptive matter, test data, or what not, issued for the purpose of keeping themselves before the public.

"An editor must judge of the availability of matter from the standpoint of the subscriber. Is it the kind of matter that the readers pay for, the printing of which will satisfy them and cause them to continue their respect for and use of the paper?

"Nobody has a more up-to-date knowledge of power-plant problems than the makers of power-plant apparatus. Each is, or should be, a specialist in his own line. Access to this knowledge would be a godsend to an editor. Much of it might be printed to the advantage of the manufacturer. Most manufacturers are either so busy that they cannot stop to tell or write what they know, or are afraid it might be of some use to their competitors, and so hide their talents and those of their designers and engineers, under a 'talk-and-be-bounced' order, instead of writing themselves and letting their people write themselves, and the firm to the front as experts and specialists in their lines."

Trade Announcements.—The "Karlsbader Kaolin Industrie Gesellschaft" has changed its title to "Zettlitzer Kaolinwerke A.G.," Porzellan Fabrik, Merkelsgrun, near Karlsbad. The firm, which manufactures all kinds of porcelain insulators, is represented in the United Kingdom by Messrs. W. F. Dennis & Co., as sole agents.

Messrs. Krupka & Jacoby, Ltd., announce that from to-morrow, Saturday, all communications should be addressed to them at 26-30, Chapter Street, Westminster, S.W., where they have taken more commodious premises, and will hold a larger stock of Graetzin lamps and other electrical goods.

Messrs. Simplex Conduits, Ltd., announce that their telephone number for the sales department, publicity and purchasing departments, and general manager's office, at 113-7, Charing Cross Road, W.C., has been changed to "4327 Gerrard," three lines.

The Stereophagus Pump and Engineering Co., Ltd., of 39, Victoria Street, Westminster, S.W., have acquired from the Hon. R. C. Parsons, a right for the sale, in this country and abroad, of the Stereophagus pump patented by him. A leaflet has been received describing the Stereophagus pump as installed at the Leeds Corporation sewage purification works.

Messrs. Mavor & Coulson, Ltd., electrical engineers, Glasgow, are making an addition to their works at Broad Street, Mile End.

Consular Notes.—Palestine.—The Austrian Consul at Jerusalem reports that the importation of petroleum motors in 1911 was active, chiefly from Germany. This German trade is due chiefly to the fact that a German machine works recently established in Jerusalem represents a German motor firm, and is in a position to undertake the installation and repairs necessary. The importation of British motors has fallen off owing to the fact that a similar British machine works, which represented a British motor firm, got into difficulties and ceased operations.

Italy.—The Austrian Counsul at Milan, reporting on the condition of the Italian electrical industry, points out that the reason for the improvement witnessed in this industry is to be traced to the establishment of new central stations for the production of electrical energy from the water power available in the country in such vast quantities. The erection of these stations has resulted in the utilisation during the last 15 years of 800,000 H.P. from the various water powers. New markets for the electric current produced have been rapidly forthcoming, largely on the part of new industries, which became possible when cheap power was available. The companies supplying current have, therefore, been very favourably situated, and they have excellent prospects. There is some fear of the possibility of over-production of articles for the electrical industry, as prices have already been pressed down as far as possible. The electric lamp industry has recently been in an unfavourable position, partly owing to the difficult credit conditions, and partly to reduced export trade. The new law, which came into force in January, 1911, lowering the duty on petroleum from 24 lire to 16 lire per 100 kg., has done the electric lamp industry some harm by increasing the use of cheap petroleum lamps in the small towns, and the demand for petroleum cooking and heating apparatus. Nevertheless, electric lighting has made greater strides in Italy than in any other European country, on account of the utilisation of water power and the consequent cheapness of the electric current as supplied by the central stations, which, combined with the introduction of metal-filament lamps, has made electricity the most popular form of lighting. The 12 to 15 million lamps used in Italy annually are for the most part imported from abroad, and chiefly from Austria, Germany, Holland, France, and Switzerland; nevertheless, there are some lamp works in Italy, but they secure only about 20 per cent. of the total consumption, and that chiefly in metal-filament lamps. The ever-increasing competition and consequent price-cutting, the big outlay necessary for advertising, breakages, &c., have made profits from this branch of the industry very doubtful. The Italian demand for electric lighting materials of brass and bronze is almost wholly satisfied by the home production, the imports from abroad being for the most part confined to specialities and novelties chiefly for show purposes. Better class glassware for electric lighting is mostly supplied by Austria, and cheaper classes by Germany. Gas lighting has suffered very much by the increasing competition of electricity, but in the towns and larger villages where electricity and gas are both available, the dwellings are fitted throughout with gas, particularly for cooking purposes. Works which are engaged in the construction of steam engines and boilers, are finding the ground cut from under their feet more and more by the competition of gas and oil motors, which are frequently used as reserve force for electrical works running on water power, and which are now being supplied in increasing quantities both by firms in Italy and abroad. The leading firms engaged in steam engine construction have, therefore, taken up the construction of gas and oil motors, so that a very keen competition has now been brought about. One field which few firms have worked which is capable of development, particularly by firms abroad, is that of the supply of small motors for benzene, petroleum, &c., which has been used for some time by the agricultural industry without any wholly satisfactory type having been put on the market. The demand for pumps continues favourable, being supplied partly by the home industry and partly from abroad. It should be noted that centrifugal pumps are increasing in popularity, as they can be directly coupled to electric motors—a very important factor. Owing to decreased competition, the electric machinery and apparatus industry has enjoyed better prices, the three important groups having come to an understanding. A relatively new field has been opened up by these firms in the supply of electric locomotives, which as a result of the successful experiments made by the State Railways with electric traction on some of their lines, have had a good reception. These experiments have been taken up to pave the way for the electrification of more important lines. The installation of new electric tramways and local railways, and the electrification of existing tramways, have proceeded apace, and have kept the electrical firms well occupied. In view of the endeavours of the Italian Government to protect home industries, the large electrical companies have more and more shown a tendency to establish subcompanies in Italy for their Italian business.

Catalogues and Lists.—Messrs. Simplex Conduits, Ltd., 116, Charing Cross Road, London, W.C.—Folder containing particulars of their combination cooking outfit. It is written in such a style as to appeal to the consumer, and is illustrated and priced. Supplies may be obtained by central station engineers and by contractors, overprinted, on application.

Messrs. Pope's Electric Lamp Co., Ltd., Hythe Road, Willesden.—We suppose there are few subjects upon which the electrical publicity illustrator has brought his ingenuity to bear more than upon metallic-filament lamps. It used to be the great merit of economical consumption that had to be driven into the public mind. Nowadays it is the quality of strength of filament and the ability thereof to stand emergency strains. Of course, we cannot spare space to illustrate all the show-cards that reach us—there is always a great deal of matter of technical and news interest which the reader wants, waiting to be used, and copies of show-cards and catalogue covers would be more appropriate in our advertisement pages than in those set apart for literary matter. In many of the show-cards that have come before us the designer has effectively got his point home, and this remark applies to a new one just issued by Messrs. Pope's company, whereon two little imps in green are doing their best to break the filament of an "Elasta" wire lamp; but it is "British made," and *will* not give way. Trade readers who have not received copies can have them on application, also a new folder giving prices of the lamps.

The London Electrical Trading Co., Ltd., Palmerston House, Old Broad Street, London, E.C.—We have received a sample showcard illustrating the Bastian F Type heaters. These cards will be supplied to the trade or any other of the wholesale agents dealing in Bastian heating apparatus, on application.

The British Thomson-Houston Co., Ltd., Rugby.—Descriptive list, No. 382, the letterpress containing a number of diagrams, concerning the B.T.-H. system of transformer protection, which system has been in satisfactory service for some years on both large and small power distribution installations; also price list, No. 386 (16 pages), containing notes on the advantage of the electric drive for printing presses, and describing (with illustrations and tabular prices and dimensional information) their printing press controllers, their construction and operation.

The Union Electric Co., Ltd., Park Street, Southwark, London, S.E.—Advance copy of their new season's list of "Excello" flame arc lamps. The list contains chiefly prices and data, and particulars of accessories, for use in conjunction with previously issued pamphlets and booklets on the same subject.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—New priced leaflets, showing their "Magnet" domestic electric irons and electric kettles and the "Pygmy" food warmer. Also a Christmas leaflet, giving particulars and prices of Robertson miniature electric lamps, in assorted colours, for Christmas and New Year decorations.

The Westinghouse Cooper-Hewitt Co., Ltd, 80, York Road, King's Cross, London, N.—Interesting booklet of 16 pages, entitled "A Bar—not a point—of Light," giving information respecting their mercury-vapour lamps for photographic work—in the studio and for photo-printing, photo-engraving and cinema work. A copy of this publication is being sent, together with list No. 27, containing a brief description of the lamp and prices, to professional photographers. The company is now settled in its new premises, as above.

Economisers, Ltd., 60, Queen Victoria Street, E.C.—A well illustrated art paper pamphlet has been issued by the company dealing with its economisers (which are made at Alfreton Ironworks, Derbyshire). A complete specification, together with tabular matter relating to dimensions, heating surfaces, economies derived, &c., notes on the installation, working and inspection of the plant, and four drawings of typical economiser arrangements, are included.

Mr. Robt. W. Paul, New Southgate, London, N.—Illustrated leaflet describing the "Omega" (G. W. Harris's patent), their improved direct-reading ohmmeter combined with a hand generator of high voltage, for measuring insulation.

Messrs. Feld Bros. & Co., Ltd., 25, Budge Row, London, E.C.—Leaflet No. G1, relating to "Colonia" direct-current motors, shunt wound open protected type, of ½ to 20 H.P., giving prices, weights, dimensions and other tabulated particulars.

Dissolutions and Liquidations.—W. Watson & Sons, opticians and dealers in electrical and other apparatus, 2, Easy Row, Birmingham.—Messrs. W. Watson and A. K. Glover have dissolved partnership. Mr. Glover will attend to debts and carry on the business.

The Black Sea Telegraph Co., Ltd.—A meeting will be held at Electra House, E.C., on January 9th, 1913, to hear an account of the winding up from the liquidators (Messrs. A. R. Hardie and W. Hibberdine).

Dutch Shipping Exhibition.—In the first Dutch Shipping Exhibition, which is to be held at Amsterdam, from June to September next year, there will be an important British Section. The Exhibition will not be run for the purpose of making profits and the officials are honorary. The Prince of the Netherlands and all the Dutch Ministers of the Crown are patrons of the movement. The Exhibition grounds are on the north side of the Y Canal, opposite to the Amsterdam Railway station on the south side and, for the convenience of visitors, there will be a constant service of steam and motor ferry boats between the two banks. For the British Section, a special pavilion is to be erected in a most favourable spot. H.S.H. Prince Alexander of Teck is the principal patron. Mr. W. R. Bisschop, LL.D., is the chairman of the British Executive Council. The manager of the British Section is Mr. J. Vandersteen, whose offices are in Sardinia House, Kingsway, W.C.

Bankruptcy Proceedings.—A. F. Mander (Mander Bros.), electrical engineer and cycle dealer, Birmingham.—December 14th is the last day for receipt of proofs for dividend. Mr. A. S. Culley, trustee, 191, Corporation Street, Birmingham.

Lighting Outfits for Italian Villas.—American Consul L. J. Keena, at Florence, has reported home on the opportunity for the sale of independent lighting plants. This, he says, should be much greater in the surrounding districts than in the city of Florence. "The small farmers would be little interested in any form of lighting plant, but throughout the mountains in this district are located numerous private villas, summer homes, pensions

and hotels. Many of these are served by small local electric lighting companies. The ordinary charge for an electric light in a villa, as made by these local companies, is $1.60 per lamp for the season (June, July, August and September). Many of these companies use water-power from small streams, and in dry weather this source of power is apt to fail, with the result that the lighting service is interrupted. Many villas, pensions, &c., which are out of range of any electric lighting company, are lighted by private acetylene gas plants. The lighting systems and apparatus used here are of Italian manufacture. There is no local manufactory of such appliances. Those on sale in Florence came from Milan and Turin. The claim made by a Milan manufacturer is that his apparatus will operate 20-c.p. lights at a cost of 1 cent United States currency per hour for each hour."

Long-Lived Electric Kettles.—A customer recently took to the office of the Manchester branch of the General Electric Co., Ltd., a kettle for repairs, stating that this particular kettle had been purchased by him in London from a G.E.C. representative 22 years ago last March, and was used continuously for 14 years in London on a 100-volt circuit, without a breakdown. Afterwards, the owner removed to Manchester and had the kettle altered to suit the Manchester voltage of 200. It has been in daily use on Manchester circuits for the past eight years, and only now for the first time has it been necessary to have it actually repaired, *i.e.*, provided with a new element. A G.E.C. electric iron and a G.E.C. fry-pan were also purchased at the same time as the kettle above referred to, and both of these are still in use.

The British Prometheus Co., of Salop Street Works, Birmingham, have received for repair an electric kettle, which has been used for about nine years without repairs, on the circuit of the North of Scotland Electric Light and Power Co., Ltd.

These incidents—which, we understand, are by no means exceptions—speak well for the durability of this class of apparatus.

Canada.—According to the Census of Canadian Manufactures, which has lately been issued, the output of electrical appliances and supplies in the Dominion during 1910, attained a value of £3,004,368.

Backward Pernambuco.—We have already familiarised our readers with the lack of public electrical facilities in Pernambuco. Of interest in connection with the question is a recently-issued American Consular Report from that city, in which the Consul states that out of 125 automobiles in use in the city, about 40 are owned by private individuals, and the rest by the five different garages of the city. He says that, when one considers the condition of the streets, which are paved throughout with cobble stones, it is strange that there are so many!

"There are also a few automobile trucks of German manufacture, but they do not seem to endure the intense strain very well. . . . A set of tires on one of the public cars lasts about 22 days. . . .

"The greatest demand, in this city at least, is for a medium-priced car very strongly built, and provided with a serviceable hood for protection against the heavy rains as well as the sun. No public motor service outside of the city would pay at present, on account of the condition of the roads, nor will the demand be materially increased in the city until the streets are paved, which will probably be done as soon as the tracks for the new electric car system are laid. The duty on automobiles amounts to about 16 per cent. *ad valorem*."

LIGHTING and POWER NOTES.

Accrington.—The Electricity Committee has decided that services shall be laid to the premises of Messrs. Lupton Bros. and Peel, Tootal & Co, for an estimated consumption of 20,000 and 60,000 units per annum respectively. A sub-Committee has been empowered to deal with an application from the Accrington Brick and Tile Co. for a three years' contract for the supply of 200,000 to 250,000 units per annum.

The supply of electricity by the Corporation is increasing. For the last quarter the units sold were 1,122,063, compared with 719,841 last year, showing an increase of 402,222. The units for power have gone up from 656,471 to 1,030,633; and for lighting from 63,370 to 75,062.

Argentina.—H.M. Consul at Buenos Ayres, states that a syndicate of British, French, Belgian and American bankers is reported in the Press to have formulated a scheme for the building of an electric power station at Buenos Ayres for the supply of electricity for motive power and lighting purposes at prices considerably below those at present prevailing. A concession has been applied for, which would, if granted, bring the German monopoly of the supply of electricity to an end. The proposed contract stipulates that the plant shall become the property of the Government at the end of 1957. Italian financiers are also said to be endeavouring to obtain a similar concession.

The German company, having its mains extended to every part of the capital, is naturally firmly established in the city.—*Board of Trade Journal.*

Messrs. Lambert Brothers, in Rojas, have acquired the Industrial del Oeste Electric Co. for $90,000. The new concessionaires mean to improve the system of public and private lighting.

Atherton.—The U.D.C. has decided to apply to the B. of T. for an order authorising it to supply electricity to certain property in the area of the West Houghton U.D.C.

Ayrshire.—The two-cell refuse destructor, erected for the burgh of Largs by Messrs. Heenan & Froude, was inaugurated last week by Col. C. C. Scott, of Halkshill. The company present inspected the installation under the guidance of Mr. J. A. Robertson, Greenock, who was consulting engineer in connection with the destructor. At a luncheon which followed, the contractors and engineer were congratulated on the efficiency with which they had done their work.

Bedford.—The T.C. has applied to the L.G.B. for a loan of £9,790 for additional plant at the electricity works.

Bentley-w-Arksey.—A difficulty has arisen respecting the supply of current to the district by Doncaster T.C. The U.D.C. had expressed the opinion that the proposals of Doncaster should not debar other persons from supplying current in the district, but the Doncaster town clerk has replied that if all comers are to be allowed to supply electricity in the district, it would make it hardly worth while for the Corporation to spend several thousand pounds in the extension. The U.D.C. has referred the question to the General Purposes Committee.

Bexhill.—The Chairman of the Electric Light Committee announced on Monday that since the commencement of the year applications for supply had exceeded the average of the last few years by 50 per cent.

Bispham (near Blackpool).—On the Electricity and Public Lighting Committee's recommendation, the U.D.C. has decided to apply to the L.G.B., for sanction to borrow £2,500, for the provision of additional lighting.

Blackpool.—The Corporation is to make application to the L.G.B. for sanction to borrow £6,300 for the purpose of extending the electricity mains. It was stated at a meeting of the Finance Committee on November 27th that there had never before been so many new customers applying for electric current as at present. The temporary set back caused by the general adoption of metallic-filament lamps has been overcome, and new customers are being connected at the rate of between 30 and 40 a month.

Bridlington.—The T.C. has applied to the B. of T. for permission to supply electricity outside the borough to the Golf Club, and residences on three estates close to the town.

Canada.—The city of Hamilton is to place its wires underground, notwithstanding the objections, legal and otherwise, of the companies interested. The Ontario Hydro-Electric Commission has ordered all electric, telegraph and telephone wires on certain of the streets, which include the principal streets of the city, to be placed in underground conduits, and that the unsightly wooden poles be forthwith taken down. Ottawa will soon follow suit, as she is negotiating with the Hydro and Railway Commissions for an order to bury her wires at least in the principal streets.

The Municipalities of Paris, Brantford, Port Dalhousie, Brockville and Prescott have signed contracts with the Hydro-Electric Commission, and other applications are now being considered.

It is proposed to spend $100,000 on a permanent means of illuminating the Niagara Falls by electricity during the evening hours, half the cost to be borne by Canada and other half by the United States. A bill was presented at Washington for $50,000, the share of the U.S.A.

There is a persistent movement on foot to get permission from the Canadian Government to dam the St. Lawrence River below the Thousand Isles, and thus obtain about a million horse-power. The promoters say that instead of this doing injury to navigation, it will aid the latter by doing away with the necessity for locks. As it involves international law, legislation from Washington would need to be obtained concurrently with that at Ottawa. The Conservation Commission is opposed to damming the St. Lawrence, and while there is some objection on the American side, yet a strong and influential body of New Yorkers is working for the scheme.

Cardiff.—Various reductions are proposed in the price of electricity in the city. For heating, cooking, &c., the rate is to be 1d. per unit instead of 1½d., and the E.L. Committee also proposes an alternative rate for power supply, viz., 1½d per unit for the first 250 units per quarter per kw. installed, and ½d. per unit afterwards.

Colne Valley (Herts).—The Colne Valley Electric Supply Co., Ltd., of 50, Queen Anne's Gate, Westminster, is applying for a prov. order for electric light in the parishes of Pinner, Bushey, Chorley Wood and Rickmansworth.

Continental Notes.—Austria.—The Austrian Imperial and Royal Central Water Board received during the month of September applications in respect of 32 schemes and 10 concessions; 12 of the former were for installations in the Tyrol, and seven in the Province of Steiermark, the largest relating to the second dam of the Etschwerk at Meran, 16,780-h.p. capacity, and the Unz River work in the Province of Carniola, 17,000-h.p. capacity. The largest installations for which concessions were granted were that in the Martell Valley, 6,500 h.p., and the Murdorf installation, near Judenburg, 1,000 h.p.—*Elek. u. Masch.*

Belgium.—The electric production of steel has given such satisfactory results during the past year at the important Belgian works of John Cockerill, as to lead to the increased use of electric furnaces, and many new installations are projected both here and elsewhere. Electric driving is now in increasing use in rolling

mills and iron and steel works, in the collieries, and in the shipyards; and, according to our contemporary, the *Zeitschrift für Elektrotechnik und Maschinenbau*, a large and steady future demand for electrical and other machinery may be confidently anticipated.

RUSSIA.—The new harbour works at Libau, for which 4½ million roubles have been voted, include the provision and erection on the quays of a number of electric cranes.—*Zeit. für Elek. und Masch.*

DENMARK.—Arrangements are in hand for a considerable extension of the electric lighting undertaking at Esbjerg.

SPAIN.—Three tenders only have been sent in for the public lighting of Madrid, in answer to the recent invitation, namely, those of the Spanish Electric Constructions Co., the "Electra" Co-operative Society, of Madrid, and the Union Electrique Modrilène. The Special Commission of Light and Water is charged to consider the tenders.—*La Lumière Electrique.*

The Alicante Gas Co. having warned the municipality that it would cut off the gas supply unless the sum owing to it were paid, the Council has retorted by deciding to break its contract with the company and to open negotiations with electric supply companies, with a view to an electricity supply. It is intended, so soon as the Civil Governor grants his sanction, to begin the work of installation.

TURKEY.—A concession is being sought for an electric light and power plant and tramway system at the town of Samsun, on the Black Sea.

Dewsbury.—The Corporation has received the sanction of the L.G.B. to borrow £3,370, repayable in 17 years, for a turbine set; £3,130 for two new boilers, repayable in 15 years; £415 for a cooling tower, repayable in 10 years; £250 for mains and services, repayable in 15 years; and £250 for meters, to be repaid in five years.

Dublin.—In accordance with the approval given by the Municipal Council to the proposals of the Electricity Supply Committee to install an additional 3,000-KW. set at the Pigeon House during the next year, the Committee reports that it has received tenders for a turbo-generator, condensing plant and accessories, and recommends the acceptance of the tender of the Oerlikon Co.

Dudley.—The sale of the Corporation's electricity works was again referred to at the meeting of the Chamber of Commerce last week, when the secretary read a letter from the B. of T. stating—in reply to a resolution passed at an open meeting of the Chamber—that the T.C. had power, subject to the approval of the department, to sell the undertaking, that the request for a public inquiry would receive attention when the deed of sale came to hand. The Lighting Committee of the Corporation has appointed a sub-Committee to carry out matters of detail with regard to the working of the power station and the supply of electricity in the borough.

Eastbourne.—The E.L. Committee has recommended the purchase of a 1,000-KW. turbo-alternator at a cost of £4,100, to be advanced out of the reserve fund.

The consideration of the report recommending the purchase of a 270-KW. Diesel engine in addition to the above for economical running, and thus reducing the cost of generating during the hours of load off the peak, was deferred.

East Ham.—A scheme has been adopted whereby the Council will supply, fix and maintain on a three years' agreement, 1,000-C.P. arc lamps (including electricity), at a charge, for two lamps, of 9s. per lamp per quarter, plus 1¼d. per lamp per hour used, and for one lamp only, of 10s. 6d. per quarter, plus 1¼d. per hour used.

Edinburgh.—The Electric Lighting Committee of the Corporation has had under consideration a motion as to the desirability of incorporating in the prov. order about to be promoted, powers for giving a supply of electricity to Barnton and other districts. A letter was submitted on behalf of proprietors in Barnton district of Cramond Parish, as to supplying a district, including Blackhall, Barnton Park, and Cramond Bridge. There were besides inquiries with regard to the supply of electricity in connection with the Colinton Barracks and tramways. It was decided to leave the matter in the hands of a small Sub-Committee.

Ellesmere Port.—The U.D.C. has resolved unanimously that application be made to the B. of T. for a prov. order authorising the Council to supply electricity within the urban district of Ellesmere Port and Whitby.

Epsom.—The U.D.C. has decided to promote a Bill in the next session of Parliament to enable it, among other things, to deal in electrical fittings, to lay down cables in private streets, and construct electrical sub-stations and other works under streets, and to empower it to make by-laws with respect to premises supplied with power from the municipal works.

Felixstowe and Walton.—A L.G.B. inquiry was held on November 26th into the application of the U.D.C. for loans of £4,052 for electricity purposes, and £1,000 for street lighting. The latter was, on the advice of the Inspector, Mr. H. L. Hooper, deferred, in order that the Council might obtain better terms for current, which is now charged at 3½d. per unit by the Electrical Supply Co. The other loan was altered to £3,930, £500 for battery extension buildings, £1,200 for battery extension, £1,730 for mains, services, switchgear, &c., and £500 for meters.

Hebden Bridge.—Owing to the steady development of the electricity undertaking since its inception nine years ago, which has made increased plant necessary, the U.D.C. has decided on the recommendation of the Electricity Committee, to purchase an additional Diesel oil engine set of 240 KW., at an estimated cost of £3,253, subject to the sanction of the L.G.B. being obtained for a loan to cover the cost.

Highland Village Plant.—An electric light installation by Edmondson's Electricity Corporation has been inaugurated in the Highland village of Beauly, the opening ceremony being performed by Mr. D. McGrath, chairman of the local company which has been formed, in the absence of Lady Lovat. Street lighting is to be supplied by 25 lamps. The current is supplied by a 40-H.P. suction gas plant, the pressure being 240 volts. Already the consumers number 150. The price charged to private consumers is 8d. per unit.

Isleworth.—The Isleworth Brewery Co. has made application to the U.D.C. for additional current to run two 250-H.P. motors; the estimated revenue is £400 per annum.

Leeds.—The system of high-pressure gas lighting installed in New Market Street, Duncan Street, and Calverley Street by the Corporation Gas Committee for demonstration purposes, has been considered by the Street Lighting Committee, who feel that the system is too costly. It has consequently requested the Gas Committee to remove the lamps within a month.

The Corporation has now given notice of its intention to obtain Parliamentary powers for the acquisition of land at South Accommodation Road, for the erection of a new generating station.

The Holbeck B. of G. has decided to install electric light in the Workhouse at an estimated cost of about £500.

Llandudno.—Consideration of the question of lighting by electricity Conway Road and Queen's Road, at an estimated cost of £398, has been deferred, and a proposal to improve the lighting of the Promenade has been referred to the chairman of the Committee and Mr. H. Morton, the electrical engineer.

The U.D.C. has referred to the electrical engineer for report an inquiry from the Ship Canal Portland Cement Manufacturers, Ltd., asking whether the Council would be prepared to supply electric current for power for an all-day demand for the Little Orme quarries.

London.—According to the *Times*, the Port Authority has decided to remove to Tilbury Dock the modern electric plant at the Victoria Dock, for which a supply of current has been obtained from the West Ham Corporation. "At Tilbury, where the Authority generates the electricity required at the Docks, the demand is growing with the increasing business, and the transferred plant will enable the Authority to provide for this demand at comparatively small expense."

MARYLEBONE.—Four converters are to be installed at the premises of Peter Robinson, Ltd. Mr. Snell has been engaged as consulting expert in connection with an additional supply, which is to be obtained for the winter of 1913-14. In consequence of reports from the general manager that the undertaking will be "very tightly placed" this winter with regard to plant capacity to meet the load, he has been authorised to negotiate with the Metropolitan Electric Supply Co. for a small emergency supply to be taken at the Aybrook Street station on the following lines:—The Council to pay for current taken at the rate of £1 per KW., and for units at a rate per unit to be agreed; the Council also to defray the cost of moving and fixing the necessary converting plant (roughly estimated at £250); also to endeavour to obtain a continuing yearly option (subject to three months' notice) on these terms. It is not anticipated that more than 500 KW. will be required.

Loughborough.—At a meeting of the T.C., the electrical engineer reported that it would be necessary next winter to put down additional plant for the general supply, in addition to the proposed extensions to meet the requirements of the Brush Co., but before making a recommendation, he asked for authority to visit Manchester. Last month the units generated showed an increase of 43·8 per cent. over the figures for last year.

Northwood and Ruislip.—The Northwood Electric Light and Power Co., Ltd., has applied to the B. of T. for an order extending the area of supply so as to include portions of the parishes of Watford Rural and Rickmansworth Rural.

Orsett.—The B. of G. has referred to the Buildings Committee the question of lighting the workhouse by electricity or gas. The Board was informed that the capital cost of an electric light plant would be £1,500, and the annual cost of maintenance, with repayment of loan, principal and interest, £172. For gas the capital cost is placed at £375, and the supply from the Stanford-le-Hope Co. would be at the rate of 3s. 6d. per 1,000 cb. ft.

Pateley Bridge.—The B. of T. has revoked the 1911 E.L. order.

Rochdale.—The Gas and Electricity Committee has decided that application be made to the L.G.B. for sanction to borrow a further £30,000 for extensions to the electricity works and plant.

Romford.—The London Electric Supply Co., Ltd., which is applying for a prov. order for electric light, has informed the R.D.C. that it is willing to extend the compulsory area in the

parishes of Chadwell Heath, Hornchurch and Upminster. The Council, before coming to any decision, has decided to ask the company to deposit plans, &c.

Rosyth, Fife.—The Government, it is believed, is about to issue schedules to contractors for the erection of a power station and experimental laboratory at Crombie, in connection with the Rosyth Naval base.

Southend-on-Sea.—A L.G.B. inquiry was held on November 27th into the application of the T.C. for a loan of £3,900 for electric light purposes. There was no opposition.

Stoke-on-Trent.—The T.C. has applied to the L.G.B. for a loan of £12,000, £2,000 for boosters, balancers, automatic regulators, auxiliary steam plant and switch gear, and £10,000 for mains, transformers, and services.

Stroud (Glos.).—Messrs. Seymour, Williams & Co. have asked the U.D.C. to waive any objection it may have to their application for a prov. order for electric supply. The Council has decided to ask for further particulars of the scheme before taking any action in the matter.

Sunderland.—An interesting electrification scheme is shortly to be commenced at the Ryhope Colliery of the Ryhope Coal Co., Sunderland. The contract includes the conversion of the North Pit haulage from steam to electrical drive, and the supply and fixing of a three-throw pump and motor. The power will be three-phase at a pressure of 2,750 volts and 40 cycles. The British Westinghouse Co has the whole contract, but the pump will be supplied by the Uskside Engineering Co. In addition to the foregoing, an order has just recently been placed for the West Pit haulage, which is an exact duplicate of that of the North Pit, and both these installations are to be completed by Easter. The North Pit haulage will be provided with a 250-H.P. continuously-rated motor working up to 400 H.P. on the gradients. The pump will be capable of delivering 300 gallons per minute against a head of 1,870 ft. A motor-generator of 75 KW. will supply energy to drive D.C. screen motors and lighting. The current will be taken from the County of Durham Electrical Power Distribution Co., at 2,750 volts, and used at that pressure. This installation will be one of the first in the Durham and Northumberland coalfields to be carried out under the new Home Office rules. The haulage at the South Pit at Ryhope is also to be converted at Whitsuntide, and tenders for this work are now being considered, and the order is expected to be very shortly placed. This haulage will be of 350 H.P., and worked up to 600 H.P. on the gradients. All of the haulages at Ryhope are at present being worked by steam from underground boilers, for which it has been necessary to take coke down the shaft, and considerable economies in working costs are expected to result from the electrification. The scheme is being carried out to the designs, and under the direction, of Messrs. Hodgkin & Young, of Darlington, acting as the consulting electrical engineers to the Rhyope Coal Co.

In connection with a scheme of dock improvements estimated to cost £24,250, the River Wear Commissioners have approved plans in which provision is made for two new electric belt conveyors at the north end of Hudson Dock North, and an electric belt conveyor at No. 13 Staith. The conveyors will consist of endless belts driven by electric power, and will carry coal at the rate of 600 tons an hour.

Tilbury.—The U.D.C. has decided to conditionally support the application of the County of London Electric Supply Co., Ltd., for a prov. order for electric supply.

Truro.—An abortive conference over the E.L. question has been held by representatives of the T.C. and the gas company, both of whom are applying for prov. orders. The point discussed was the withdrawal of one of the applications, but no agreement was arrived at.

Uruguay.—An American Consular report states that some time ago the Government caused technical studies to be made on the possibility of utilising the Rio Negro, an important river crossing a large portion of the Republic, to produce power for an electric station capable of supplying all the requirements of Monte Video, the resulting reports being entirely favourable. It is intended to erect the power station on the river by constructing a dam nearly 3 miles long and a transmission line for energy 162 miles in length. The cost of the works is estimated to be $8,500,000, not counting the value of expropriations which, added to the cost of deepening the river to 5·9 ft. (now in progress), will bring it to $11,500,000. The power house will be able to supply 120,000,000 units annually—four times the present consumption—and would be able to furnish power to tramway and manufacturing companies. When in full operation there would be a saving of £1,200,000 each year in coal, besides bringing about many advantages in the economy of light and the establishment of various industries outside of the capital, which to-day cannot exist owing to the high price of coal. A Bill will be presented to the Chambers asking for authority to complete the project, which is at present in charge of an American engineer.

Whitstable.—A prov. order for electric light is to be applied for by a local company, which has received promises of considerable support, both in the town and at Tankerton, a residential suburb.

Worthing.—The Electricity Committee of the T.C. has decided that in future service lines are to be laid free of charge to the extent of 100 ft. instead of 60 ft., and to allow consumers of up to 1,000 units per annum a discount of 5 per cent., and those taking over 5,000 units per annum, 10 per cent.

York.—The Corporation has decided to insert in the Corporation Gas Bill to be introduced in the next session of Parliament, clauses which will empower it to purchase land from the Foss Navigation Committee for the purpose of constructing a reservoir for condensing purposes at the electricity works, it being stated that the Navigation Committee is unable to guarantee such a supply.

TRAMWAY and RAILWAY NOTES.

Accrington.—The Town Clerk has reported to the Electricity Committee that he has written to the Rawtenstall Corporation, inquiring how many of the Corporation's cars running to Accrington had been converted from the regenerative control system as required by the B. of T. He read the following resolution from Rawtenstall Council in reply:—"That seeing the arrangements with respect to through running are no more satisfactory to this Corporation than to Accrington, this Corporation hereby expresses its willingness to terminate the agreement with respect thereto." A Committee was deputed to confer with Haslingden Corporation on the subject. Later the Town Clerk reported that he had written to Rawtenstall, reminding the Council of its resolution passed last February, giving instructions for the conversion of cars as soon as practicable.

Argentina.—Mr. F. Robetti has applied to the Government of the province of Buenos Ayres for permission to construct an electric tramway from Ostende station in the district of General Madariaga, to the Atlantic.

The Statutes of the Compania de Tramways Eléctricos Buenos Ayres have been approved. The company has been formed to work the concession for lines in Vicente Lopez and San Martin, and also to engage generally in concessions for omnibuses, tramways, and railways in any part of the Republic.—*Review of the River Plate.*

Asiatic Turkey.—A concession has been granted for an electric tramway from Scutari to Kadikeuy on the Asiatic side of the Bosphorus, to a French syndicate.

Australia.—The report of Mr. Hay, the engineer engaged by the New South Wales Government to report upon the traffic problem of Sydney, was laid upon the table of the Legislative Assembly recently. Briefly, the report recommends the following:—(1) A bridge to North Sydney from Dawe's Point to Milson's Point; (2) an underground city railway, with three-minute service; (3) a partly underground railway for the eastern suburbs; (4) a western underground railway through Balmain and Leichhardt; (5) the undergrounding of the King Street tramways; and (6) a goods tunnel from Woolloomooloo to Circular Quay, or Darling Harbour. The city railway and the King Street undergrounding are regarded as the most urgent works, and it is estimated that these could be completed within two to two and a half years. The estimated cost of these is (excluding the harbour bridge, and also excluding throughout electrical equipment, signals, rails and land resumption), £4,516,070, made up as follows:—City railway, £1,175,273; eastern railway, £995,058; western railway, £2,134,510; King Street tunnel, £112,420; Woolloomooloo tunnel, £98,809. The Minister for Public Works thoroughly agrees with Mr. Hay's recommendation that the city underground railway should be first constructed, and sums have been placed on the loan estimates for the current year so as to be in a position to start the preliminary work immediately the approval of Parliament has been obtained.—*Tenders* (*Mining and Engineering Review*).

Belfast.—At a meeting of the Tramways and Electrical Committee the manager of the tramways presented a statement with reference to proposed extensions of the electrical department, and submitted a scheme for generating electricity for tramways purposes only by installing Diesel engines in the present tramway depôts. Mr. Nance's suggested scheme was as follows:—(1) The electrical undertaking is to be placed in possession of the generating station, switchboards, engines, coal conveyor and all other properties paid for by, and belonging to, the tramway department within the limits of the present electric generating station in East Bridge Street, and to pay to the tramway department for them, "the present value" of the amount spent thereupon—namely, £96,155—to be settled by the city accountant with an assessor, if thought desirable; (2) the electrical undertaking to provide a new station for the transforming plant now in the Antrim Road tramway depôt, and the cost of such transfer and new station to be paid by the tramway undertaking; (3) the tramway undertaking to establish Diesel oil-engine generators, amount in all to 6,000 KW., in 500-KW. sets, in the various depôts around the city, with buildings and other requirements; to make necessary alterations in feeders, and to hereafter, under the authority of the general manager of the tramways and under the direct supervision of the chief engineer, supply all the electrical energy required for tramway purposes, and maintain all electrical equipment. The estimated cost of this installation, with the necessary changes in feeders and buildings, will amount to £101,500 (estimated). Mr. Nance claims for his scheme simplicity, economy, abolition of dual control, relief of the electrical undertaking from its present embarrassment and provision against rise of prices. This report was

submitted to Mr. Bloxam, the city electrical engineer, for his comments thereon to the Committee, and at a special meeting last week Mr. Bloxam analysed it in detail, and pronounced the first part to be unworkable; he pointed out that the present electric station output is limited by its boiler capacity, that any advantages which the development of the Diesel engine and oil fuel may make possible will be availed of by the whole undertaking, and not reserved exclusively for the tramway service, and so forth. The Committee by 9 votes to 3 decided not to take any action on Mr. Nance's report.

Blackpool.—A Daimler 'bus of the petrol-electric type was tested by members of the Corporation on Saturday. This type of 'bus is intended to run in suburban districts in which there is no tramway service. At a meeting of the Council on November 28th, Alderman Brodie said the Tramways Committee had under consideration the advisability of providing vehicular accommodation for one or two districts in Blackpool to meet the public convenience. There was no hope of any tramway service paying its way off the tram-track already laid. Councillor Tillotson inquired why private enterprise should not be allowed to provide the service, and recalled the time when former 'bus proprietors in the town were deprived of licences and defeated when they took the case to London. He failed to see why the Corporation should embark upon such an undertaking, and yet private owners had been refused the power.

Bradford.—The profits on the tramways for the half-year ended September 30th show a serious decrease on the corresponding half of last year, this being chiefly accounted for by the increased expenditure on repairs to permanent way, cars and rolling stock, power and wages, and the introduction of ½d. fares up to 9 a.m. The half-yearly statement shows a profit of £25,997, against £35,867 last year, being a decrease of £9,870. The traffic income has been £143,358, being £993 less than last year, in spite of increased car-mileage of 127,000. If the same rate of earning per car-mile had been maintained as last year (11·913d.), the income would have been £6,000 more. Repairs of the permanent way show an increase of £2,109, and cars and other rolling stock an increase of £2,008. Power expenses have increased to £992; traffic expenses, including wages of motormen, conductors, &c., have been £36,624, against £34,480 last year. The railless route undertaking shows a loss for the half-year of £181; the expenses being £798, against a revenue of £617. Income from the carriage of parcels was £4,242; expenses, £3,926; profit, £316.

Continental Notes.—HOLLAND.—A concession has been granted to the Municipality of Arnhem for the construction of an electric tramway from Arnhem to Velp, and from Arnhem to Oosterbeek, a total distance of about 10 km. The Municipality must submit to the Minister of Commerce detailed plans of the line and of the electric power station within a year from the date of the concession, viz., November 2nd, 1912.

BELGIUM.—La Société des Tramways Electriques de Gand has just applied for a concession to construct and work a new line of electric tramway in the town of Ghent—between the Gand-Sud Railway station and the Boulevard de Roygem.

FRANCE.—Plans are being prepared in respect of a projected electric railway between Castres and La Salvetat (Herault).

GERMANY.—In connection with the electrification of the mountain railways in Silesia, the Prussian State Railway authorities have lately placed a contract with the Siemens-Schuckert Werke for 20 electric locomotives for goods trains, and with the A.E.G. for five trains for the same system of railways.

The first trials of the railways in the Wiesen Valley in the Lorrach district of Baden, which have just been electrified, were recently made. It is not expected, however, that the lines will be opened for traffic until next year.

Coventry.—The City Council decided this week to apply to Parliament for power to run motor-omnibuses within the city, and also along the route of the Corporation tramways.

Glasgow.—Some remarkable figures are given in the half-year's report in connection with the working of the Corporation tramways. For the six months ending November 30th, the total number of passengers carried reached the total of 150,016,653, as compared with 128,801,034 for the corresponding period of 1911—an increase of nearly 24¼ million passengers. During the year, the halfpenny stage was doubled in length, and the detailed figures show that this fare accounts for 60·69 per cent. of the entire traffic, the figures being 91,040,168 against 35,777,328 for the corresponding six months a year ago. While, however, the total carried has gone up, the revenue has fallen £9,485, caused by a big diminution of travellers on the penny stages and longer distances. The number of people who took penny tickets has fallen from 46·27 last year to 28·58 this year—the figures being 59,596,464 in 1911 and 42,876,350 this year. There was also a decrease in the 1½d. and 2d. stages, the figures being 10,055,008 and 3,170,896 respectively this year, as against 10,360,902 and 3,236,202 in 1911. The 2½d. stages were patronised by 1,477,822, as compared with 1,424,569; while those travelling 3d. stages and longer distances represented 1,396,410, against 1,361,631. The total decline in receipts is, as stated, £9,485, the six months' income from fares being £492,054, against £501,539. The halfpenny stage yielded £189,667, as compared with £74,536: but the money taken for penny stages was only £178,651, against £248,318 in 1911. A striking point in the report is that while the halfpenny stage passengers represented 60 per cent. of the total traffic, the receipts from the same class of patrons were less than 39 per cent. of the total revenue.

There appears every prospect of the T.C.'s new Committee on tramways pressing forward for the further extension of the system both within and without the city. Powers were obtained in certain omnibus Bills and prov. orders to lay tracks, which have not yet been taken advantage of, and the expectation is that those privileges will within a comparatively short time be put into active operation. Nothing definite has yet been decided on, but it is significant that the Committee in charge of extensions is making tours at present to several of the outlying districts. Among the districts scheduled and to be inspected are those of North Kelvinside, Canniesburn, Milngavie, Scotstounhill, Govan, Netherlie, Clarkston, Whitecraigs, Provanmill, Coatbridge and Cothkin. If the scheme is gone on with in its entirety, it will mean the addition of from 10 to 15 miles to the system.

Greetland.—The U.D.C. has formally approved of the Huddersfield Corporation's proposal to construct a single line of tramways along Saddleworth Road, to the Halifax Corporation's tramways in Halifax Road, subject to the Council being satisfied as regards the terminus of the tramways in Halifax Road.

Huddersfield.—The Corporation has formally resolved to promote in the ensuing session of Parliament a Bill authorising the construction of tramways in the borough, in the borough of Brighouse, and in the urban districts of Elland, Greetland, Slaithwaite, Linthwaite and Marsden, and in the parish of Fixby; and the provision and running of omnibuses and motor-cars on the railless trolley system within and without the borough.

India.—The formal sanction of the Government of India has just been received by the Mysore Government for the commencement of electrical tramways for Bangalore City and station. Orders will now be placed in Europe and America for plant and material, and the project is expected to be accomplished in 13 months.

Leeds.—The recent dismissals of motormen and conductors on the Leeds tramway system have occasioned some resentment, and it has been decided by the members of the Tramway and Vehicle Workers' Society to hold a meeting of all sections of the men. Mr. J. B. Hamilton, tramways manager, in the course of an interview with a Press representative, said that it seemed to him that a clique of the Union officials would like to control the tramways in their own interest, and to the disadvantage of the non-Union men.

The Corporation has given notice of its application for Parliamentary powers to make various tramway and railless traction extensions, referred to previously in our columns.

Liverpool.—The electric tramway system is being linked up in one of the suburban districts by motor-omnibuses under the control of the Corporation, and already a passenger service between the Menlove Avenue tramways terminus at Calderstones and the town of Woolton is in operation. So far only one new vehicle is in use in addition to three of a more or less obsolete type. The omnibus, which has cost between £750 and £800, is of 40 H.P., and is of the petrol-electric type. The Corporation has ordered a second 'bus of similar power, which is almost ready for delivery.

The additional electrified track on the L. and Y. Railway between the Exchange Station, Liverpool, and Sandhills, was brought into use on Monday.

Llandudno.—The U.D.C. has received from the Llandudno and Colwyn Bay Electric Railway, Ltd., notice of the latter's intention to apply to the B. of T. for sanction (*inter alia*) to abandon so much of Railway No. 6, authorised by the company's Order of 1898, as lies between Deganwy and West Parade, Llandudno.

London.—SOUTH-WESTERN RAILWAY ELECTRIFICATION.—It is reported that the scheme for the electric working of the Kingston and Hounslow loop lines, and the Shepperton and Hampton Court lines of, the South-Western Railway has been drawn up, and will shortly be submitted to the directors. A power house is said to be part of the scheme on which work is expected to commence next spring, and to continue for two years.

A complete electrical ambulance service has just been installed by the Port of London Authority. It is estimated that the service will cost £4,000 per annum to maintain.

LEWISHAM.—Objection is to be raised to the proposal of the L.C.C. to run railless trolley vehicles from Catford to Sydenham, as the local Council has consistently objected to the erection of overhead wires in any form.

Newcastle-on-Tyne.—For the past half-year's working of the Newcastle tramways, the gross receipts were £115,359, an increase on the corresponding period of last year of £2,163. The total working expenditure showed an increase of £3,837, and there is a gross surplus for appropriation on the half-year of £18,658, being a decrease of £443. After paying £12,000 in relief of the rates, there is a net profit of £6,658. The increased expense is due to more traffic, needing more men; greater expenditure on up-keep; and concessions to the men.

Ripley.—A conference was held on Friday last between Mr. Williams, representing the Notts. and Derbyshire Tramways Co., and the U.D.C. with reference to the proposed tramway service between Nottingham and Ripley. Mr. Williams stated that the capital for the scheme which the company was promoting was now fully subscribed, but it could not at present extend the scheme to Belper, as the cost of road widenings would be prohibitive. The company would enter into a written guarantee that the road widenings along the line of route throughout the Ripley Council's

district, with one stipulated exception, should be 24 ft. wide. The Council decided to accept this guarantee and pass the plans.

York.—At the City Council on Monday, a resolution was brought forward on the recommendation of the Tramways and Electricity Committee that the Council purchase the old Liberal Club in Clifford Street for offices at a cost of £4,000. The matter was referred back for further consideration. The tender of Mr. Wm. Dobson, of Edinburgh, of £15,147 for the construction of the track for the Bishopsthorpe Road tramway extension was accepted.

TELEGRAPH and TELEPHONE NOTES.

Canada.—In Canada, on December 1st, the new combined land rates for wireless messages, which were fixed during the International Conference last June, came into force. Messages to ships on the high seas can be handed in at any telegraph office in the Dominion.—*Financier.*

Congo.—A wireless installation has been set up at the station at Kabelend, in Loango, in the Belgian Congo, which is in connection with 11 others in this territory. The equipments are on the Telefunken principle, and have a power of 1½ KW., with a range of 500 km. with the larger and 200 to 300 km. with the smaller installations. The network embraces a primeval forest region 4,500 km. in extent.—*Elek. und Masch.*

France.—A Government Bill has been laid before the Chamber of Deputies for the establishment of a system of wireless telegraphy between France and the French Colonies, consisting of two chains of wireless stations, viz., the Eastern line, with stations in the South of France, in Tunis, Jibuti, Pondicherry, and Cochin China, with a branch to Madagascar; and the South American and African line, starting from the same station in the South of France, connecting with stations in Morocco, Colomb-Béchar, Senegal, Timbuctoo, Bangui, and Martinique. These systems will be followed by a connection across the Pacific, with stations at Noumea and Tahiti. Finally, it is proposed to erect a station in the West of France for communication with North America. It is estimated that the total cost of the complete system suggested will be over £800,000.

Imperial Wireless System.—On Wednesday last week the Select Committee resumed the inquiry regarding the Marconi agreement. Mr. Beech Thompson, of the American Poulsen Co., read communications which he had received from the secretary of the Federal Telegraph Co., at San Francisco, between November 16th and 22nd, stating that communication had been established throughout the day. A letter from Mr. Godfrey Isaacs, of the Marconi Co., to the Committee was also read, communicating a telegram received from the Marconi Co. in America, in which the working of the Poulsen system between San Francisco and Honolulu was criticised. Mr. Thompson stated that the manager of the United Wireless Co. had telegraphed to him at San Francisco asking the lowest price for the assets of his company and the Poulsen patents. His company could not take a contract with the British Government, but the English company had arranged to acquire the use of the American improvements. He would not say how much of the nominal capital of his company (£5,000,000) had been subscribed.

Mr. Madge was further examined, and stated that in his opinion the system ought to be carried out by the Marconi Co. or the Poulsen Co.; they would make a better job of it than the Admiralty.

Regarding the production of documents, Capt. Charlton stated that the Admiralty would produce the conclusions, but not the data on which they were based, and Lord Robt. Cecil expressed dissatisfaction.

On Thursday Mr. Madge was again examined, and said that the Marconi designs were on sound engineering lines; the company possessed most valuable experience and an expert staff. He thought the duplex working could be accomplished. The Poulsen system would be cheaper to install and to maintain, but was in its infancy, and the staff was not experienced. The Marconi system was the better at present, though the Poulsen was more likely to develop. He had no doubt that the Poulsen system had effected communication between San Francisco and Honolulu in the daytime. In his opinion, the Admiralty could build long-distance stations without using the Marconi patents. He had no interest in any system of wireless telegraphy. Lieut. Fitzmaurice was examined, and corroborated Mr. Madge's evidence.

On Monday a letter from the Admiralty was read, quoting the rule governing the production of evidence before a Select Committee, and stating that officers giving evidence would have full permission to produce documents to the Committee, except in the case of papers relating to war arrangements. Captain Charlton outlined the events which led up to the agreement, and stated that the existing contract between the Admiralty and the Marconi Co. had been very hard on the former, the company having kept them strictly to its terms. The Admiralty being unable to communicate any information in wireless telegraphy to another department, the army had to carry out experimental work which had been covered years before by the Admiralty, so that the country paid twice over for the same work. Further, the new Australian warships could not be equipped with the same wireless apparatus as the ships of the Royal Navy. He approved of the final agreement. The company would not make any profit on the erection of the stations, but would make a big profit on the receipts if the system was a commercial success. The Admiralty had four long-distance stations—at Gibraltar, Malta, and two in England. They had no doubt they could work over 2,000 miles. The Admiralty attached very great importance to secrecy regarding their wireless service, which, together with their special methods, enabled them to obtain greater reliability of service and made interference by jamming more difficult. It would be most undesirable that any inspection of their apparatus should take place. Naval stations ought to be erected by the Admiralty, for the sake of secrecy. The Admiralty preferred simplex to duplex working, for military purposes, as a single station was more easily defended. If they had commenced work in 1911, they could have completed the stations by the end of 1914. The matter was most urgent a year ago, but several other nations now had long-distance chains in hand, and unless one could be first in the field, so as to be able to choose one's own wave length, there was not much to be gained by haste. If they had to start afresh, there would be at least four systems to consider, and if they waited longer there would be more. If they were starting now, stringent terms should be made to enable them to change the system if necessary. The Admiralty had made progress in the science during the past nine months, which would not have been possible if the Admiralty staff had been occupied in building the Imperial chain of stations. They were indebted to information derived from the Marconi Co. for the progress they had made. The Admiralty very much regretted the delay in carrying out the scheme. To have invited tenders would have taken a long time.

Large Pension Fund.—The American Telephone and Telegraph Co. and associated companies (Bell system), the Western Union Telegraph Co., and the Western Electric Co. have set aside a sum of two million pounds for pensions, sick benefits and life insurance for their employés, who number 175,000. The latter do not contribute to the fund, which will be used for the benefit of employés of all ranks. The aggregate wages paid by the companies amount to about £23,000,000 per annum.

Submarine Telephone Cable.—A large submarine cable has been laid by the Pacific Telephone and Telegraph Co. across the bay between San Francisco and Oakland. The cable, says *Telephony*, contained 154 pairs of No. 19 conductor, paper-insulated and lead-sheathed, with steel armour; it was 23,000 ft. long, weighed 16 lb. per ft., and was provided with loading coils. It was laid in two sections, landing at Goat Island, where the loading coils were inserted. The cable was made at Chicago, and was laid by a cable-carrying lighter, which has been specially built for the purpose by the company, on account of the increasing number of submarine cables employed in the coastal towns.

Telephone Employés' Grievances.—To protest against the application of an "unjust classification" to the ex-National Telephone Co.'s staff, a largely attended meeting of the Bradford branch of the Amalgamated Society of Telephone Employés was held last week. A similar meeting was held at Edinburgh, and it was unanimously agreed to draw the attention of the Postmaster-General to the classification, and ask that the terms of the Telephone Transfer Act, 1911, and the promises given by him in the House of Commons be carried out.

Telephone Numbers as Telegraphic Addresses.—The Postmaster-General has issued a notice reminding telephone subscribers of the existing facilities for securing, by the use of the addressee's telephonic address, the expeditious delivery by telephone of telegrams to telephone subscribers. This address consists of the subscriber's name, the name of his exchange, the number of his line and the name of the town in which the exchange is situated. When the name of the exchange is also the name of the town, or of a well-known locality, the name of the town may be omitted. The name of the town is not required when a telegram is addressed to an exchange number in the same town. Subscribers are recommended to print their telephonic addresses on their notepaper as their addresses for telegrams. Confirmatory copies of telegrams delivered by telephone will be sent by post without charge to the address in the Telephone Directory in daily batches, and, if the attention of subscribers cannot be obtained by telephone, telegrams will be delivered in the ordinary way by messenger.

The Telephone Service.—In a letter addressed to the Liverpool Chamber of Commerce, the Postmaster-General proposes that local advisory Committees be formed, to assist him in the administration of the telephone and telegraph services. These Committees will take the place of the general advisory Committee suggested by the Chamber last year.

Wireless Telephony.—Experiments have been carried out at Rome by the Minister of War with new types of transmitter and water microphone, the inventions of Profs. Moretti and Vanni respectively, with a view to opening telephonic communication with Tripoli. The wireless stations at Penzano, Madelena, Palermo and Trepane were telephoned to, and communication was successfully established. The results of the experiments have decided the War Department to appropriate the inventions for exclusive military use, a present of them to the Italian Government having been made by the inventors.—*Zeit. für Schwachstromtechnik.*

The World's Wireless Stations.—According to the statistics of the International Wireless Bureau, the wireless stations established in the different countries of the world, up to July 15th last, numbered 1,188 on warships, 1,262 on merchant ships, 371 on land for public service, and 114 on land for military purposes. Of these, Great Britain had 455 stations on merchant vessels, and 43 public land stations; Germany, 206 and 22; United States, 253 and 142. To these must be added 58 stations in various Colonial possessions.—*L'Industrie Electrique.*

CONTRACTS OPEN and CLOSED.

OPEN.

Abertillery.—December 16th. 100-KW. Diesel engine and dynamo, water-cooling apparatus, pipework, overhead crane and switchboard panels and connections, for the U.D.C. See "Official Notices" November 29th.

Australia. — SOUTH AUSTRALIA. — December 18th. Telegraph and telephone material, for the P.M.G.'s Department. See "Official Notices" November 8th.

December 17th.—Three sections of common-battery multiple switchboard and other equipment, for the P.M.G.'s Department. See "Official Notices" October 25th.

VICTORIA.—December 31st. Thirty detectors, for the P.M.G.'s Department. See "Official Notices" November 22nd.

January 10th, 1913.—Prahran and Malvern Tramways Trust (V.) invites tenders for trucks, wheels, axles, motor equipment and brakes. —*Australian Mining Standard.*

January 24th, 1913. Two 4,000-KW. steam turbo-alternators, for the Melbourne City Council. See "Official Notices" November 22nd.

January 28th.—Thirty-three miles of paper-insulated lead-covered cable for P.M.G., Melbourne. High Commissioner's Office in London, 72, Victoria Street, S.W.

NEW SOUTH WALES.—December 11th. Telegraph cable, for the P.M.G.'s department. See "Official Notices" November 1st.

SYDNEY.—January 20th, 1913. Storage batteries, motor-generators and switchgear. City Electrical Engineer, Town Hall.

January 8th and 22nd.—Fifty induction motors (Specification No. 386); two turbine-driven centrifugal pumps (Specification No. 390). Chief Commissioner, New South Wales Government Railways, Sydney.

TASMANIA (HOBART).—January 13th. P.M.G.'s department:—Paper insulated, lead-covered cables. See "Official Notices" to-day.

QUEENSLAND.—January 29th, 1913. Detectors (Schedule 242), for the P.M.G.'s Department. See "Official Notices" to-day.

VICTORIA.—February 21st, 1913. Four 1,500-KW. rotary converters, for the Melbourne City Council. See "Official Notices" to-day.

Austria.—VIENNA.—December 11th. The Minister of Trade is prepared to receive tenders for the supply, during the period January 1st, 1913, to December 31st, 1915, of safety apparatus for low-pressure current services, of the kind and quantity usually prescribed, subject to 30 per cent. increases. Particulars from the K.k. Postokonomieverwaltung, Postgasse 17, Vienna I.

Balderton (Notts.).—December 14th. The Parish Council invites tenders for an electrical installation for street lighting. For further particulars see this column for November 22nd.

Beckenham.—December 9th. Electricity meters, for the U.D.C. See "Official Notices" November 29th.

Brussels.—January. Tenders are invited for the supply of (1) two cables and their accessories to unite the Brussels telephone exchange (Rue de la Paille) with the exchange at Antwerp (Rue des Frères Cellites); (2) a cable to connect the exchange at Schaerbeck (Rue Jan Blockx) with Dieghem (Special Conditions No. 3,601). Particulars, Salle de la Madeleine, Brussels.

LIEGE.—December 16th. Tenders are required for the supply and erection of the cables and accessories for the electric installation to work the guns of position at the forts of Antwerp, in four lots. The first comprises the whole of the cable material requisite for the glow-lamp lighting service, and for the electric projectors and motors in 13 new forts and 12 redoubts; the second lot, similar material for the four existing forts in the first line of defence; the third lot comprises the supply of switchboards to the 13 new forts and 12 redoubts; and the fourth lot the supply of switchboards to the four existing forts. Further particulars from the Fonderie de Canon, 80 Quai St. Léonard, Liége. Tenders should be sent in 48 hours before 10 o'clock on the date of adjudication above mentioned.

December 16th.—Tenders are invited for the supply of 46 continuous-current dynamos for the previously-named forts and redoubts as per Cahier de Charges Spécial No. 7. Also, on the same date, for similar destinations and purposes, 46 semi-stationary steam engines, as per Cahier de Charges Spécial No. 6. Further particulars from, and tenders to, Fonderie de Canons, 80, Quai St. Léonard, Liége.

Colchester.—Electric light installation, West Ward School, for the T.C.; Borough Electrical Engineer.

Dewsbury.—December 17th. Two water-tube boilers, superheaters, mechanical stokers, &c., for the Corporation electricity works. See "Official Notices" November 29th.

Dundee.—December 20th. 5,000-KW. steam turbine and alternator, condensing plant, and one 500-KW. rotary converter with transformer, for the Corporation. See "Official Notices" to-day.

Eastbourne.—December 16th. 99 long-burning flame arc lamps for street lighting, and sale of 99 open-type double-carbon lamps to be displaced, for the Corporation. See "Official Notices" November 22nd.

France.—January 15th. Concessions for six railway schemes in the Department of Calvados, France, are offered for public competition. The lines are to be of 1 metre gauge, and the service to be either electric or steam. For further particulars see this column last week.

London.—HACKNEY.—December 12th. Open type and flame arc lamp carbons, for the B.C. See "Official Notices" November 22nd.

LAMBETH.—December 10th. The Guardians want tenders for three electric lifts, including removal of existing lifts, at Renfrew Road Workhouse and Brook Street Infirmary. Specification (deposit £2, returnable) from the Clerk to the Guardians, Brook Street, Kennington Road, S.E.

FULHAM.—January 9th. Steam dynamo, switchboard and connections for the Workhouse, Fulham Palace Road, W., for the Guardians. See "Official Notices" to-day.

Manchester.—December 17th. (*a*) Portland cement; (*b*) Steel bolts and nuts for fish plates; (*c*) Self-acting sliding lathe; (*d*) Cleaning and dyeing of car curtains. Mr. J. M. McElroy, Corporation tramways general manager.

New Zealand.—January 6th, 1913. Switchboards, for the Auckland Harbour Board. See "Official Notices" November 15th.

Pembroke.—The time for sending in tenders for a refuse destructor at the electricity works has been extended to December 10th.

Santa Fé.—The municipality of Reconquista will shortly call for tenders for an electric light and power station.—*Review of the River Plate.*

Spain.—MADRID.—The T.C. is open to receive offers for the supply of electric material and other necessary articles of municipal requirement for the financial year 1913-14.

December 23rd.—The authorities of the Fabrica de Artilleria de Trubia, at Trubia, are inviting tenders for five 20-H.P. electromotors, four of 30 H.P. and four of 50 H.P.

December 28th.—The municipal authorities of Carballo (province of Coruna) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years.

Tenders have just been invited by the municipal authorities of Huesca for the concession for the electric lighting of the town during a period of 10 years.

South Africa.—December 31st. 107,580 yards of insulated wire, 6,336 yards of flexible wire, and 25 cwt. of bare copper wire, for delivery during February next. Tenders to Secretary to Tender Board, S.A. Railways Headquarter Offices, Johannesburg. Further particulars at the B. of T. Commercial Intelligence Department in London, and in the current *Board of Trade Journal.*

Trimdon Grange (Co. Durham).—December 7th. Electric fittings for a year, for the Trimdon Grange Colliery. The Storekeeper.

Warrington.—The Tramways Manager has been authorised to advertise for tenders for three motor-omnibuses.

CLOSED.

Accrington.—The Electricity Committee has accepted the tender of Messrs. T. Blackburn & Sons, Preston, at £249, for a steel roof over the boilers, &c., at the electricity works.

Atherton.—The Electricity Committee has accepted the tender of Messrs. Hanchett, Barratt & Co., Pendleton, for the supply of two 20-K.V.A. transformers.

Australia.—The *Mining and Engineering Review* (*Tenders*) reports the placing of the following contracts:—

VICTORIA.—P.M.G.:—

50 miles of copper wire.—Lawrence & Hanson Electrical Co., Ltd.
1,150 common-battery telephones and 1,000 condensers.—Western Electric Co. (Australia), Ltd.
240,000 porcelain insulators.—British and Foreign Indent Co.

Prahran and Malvern Tramway Trust:—

Duncan & Fraser, Adelaide.—Construction of 11 bogie cars, at £775 each. The other tenders were:—A. Pengelly, Adelaide, £1,150; J. McBride, Melbourne, £925; and Noyes Bros., Melbourne, £964.

According to the *Australian Mining Standard*, the following contracts were placed in October:—

SYDNEY.—P.M.G.:—

Purchase of wireless telegraph material, £7,890.—Maritime Wireless Co. (Shaw System), Ltd., Sydney.

MELBOURNE.—P.M.G.:—

Battery material, £390.—L.-R., G.-P. and T. Works Co., Ltd.
Bolts and nuts, £1,135.—Mephan Ferguson Pty., Ltd.
Paper-insulated lead-covered cable, £2,930.—W. T. Henley's Telegraph Works Co., Ltd.
Wireless telegraph gear, £150.—Maritime Wireless Co.

Bacup.—The contract for the installation of electric light at the baths has been secured by Mr. G. L. Adamson, of Rochdale.

Bedford.—The T.C. has accepted the tender of Messrs. W. H. Allen, Son & Co., Ltd., for a 400-KW. Diesel oil engine-driven alternator, at £8,980.

Barrow.—The T.C., on December 2nd, accepted the following tenders in connection with the extension of the electricity works :—

Steam turbine and three-phase alternator.—James Howden & Co., Ltd., £3,237.
Rotary converters with exciters and transformers.—British Westinghouse Co., Ltd., £2,818.
High and low-tension switchboards.—British Thomson-Houston Co., Ltd., £3,922.
Condenser and pumps.—Willans & Robinson, £1,142.
Steam and exhaust pipes, valves, &c., weigh tank and recorder.—E. Le Bas and Co., £1,239.
Water tube boiler.—Babcock & Wilcox, Ltd., £1,027.
Coal conveyor, weighing machine.—E. Bennis & Co., Ltd., £744.

The acceptance of a tender for mechanical stoker was deferred pending further inquiries.

Bolton.—The Tramways Committee has accepted the following tenders :—

Dick, Kerr & Co.—Six sets of bogie car equipments, and ten sets of single truck equipments.
United Electric Car Co.—Six bogie car bodies.
Milnes, Voss & Co.—Ten top covers for single-truck cars.

The Electricity Committee has accepted the tender of Messrs. E. Bennis & Co. for an ash elevating plant for the electricity works.

Bridlington.—The T.C. has accepted the tender of Messrs. Stuart & Moore, of Ealing, W., for electric fire alarms, at £107.

Brighton.—The Corporation has placed a renewal order for the supply of Wotan pure drawn tungsten lamps, for the whole of the street lighting during the next 12 months, with Messrs. Siemens Bros. Dynamo Works, Ltd.

Cardiff.—CORRECTION.—We are asked to state that the notice published in our last issue respecting a contract being placed with Messrs. Bennis for coking stokers and self-cleaning compressed-air furnaces for Roath power station, Cardiff, is quite incorrect. No such contract has been placed, nor, indeed, was such a tender received. Furthermore, the Cardiff Committee is not contemplating placing such a contract at the present time. Vicars's stokers are fitted to all boilers at the station, and they have been in operation for 12 years.

Christchurch.—The B. of G. has accepted the tender of Messrs. Andrews, of Boscombe, for the electric light installation at the workhouse, at £643, the costs of lamps (£84) having been deleted from the contract at the instance of the L.G.B., who intimated that the Guardians must purchase lamps as they require them.

Doncaster.—The Corporation Tramway Department has placed an order with the Albion Motor Car Co., Ltd., of Glasgow, for a 32-H.P. motor tower wagon, for overhead conductor maintenance work.

Dublin.—The Electricity Supply Committee of the Corporation, in a report on tenders for a new 3,000-KW. turbo-generator plant, considered at Monday's meeting of the Council, states (according to the *Dublin Daily Express*) that, in reply to advertisements, only three complete tenders were received, as follows :—

A.E.G. Electrical Co.	£11,200
Maschinenfabrik Oerlikon	11,351
C. A. Parsons & Co.	13,226

Dealing with these, the Committee says :—The specified date for completion is September 30th, 1913. Both the A.E.G. Electrical Co. and the Maschinenfabrik Oerlikon guaranteed completion by the date mentioned, but Messrs. Parsons could not guarantee delivery under 12 months from the receipt of the order. As the set will be required for regular use to meet the winter load next year, the Committee could not consider Messrs. Parsons & Co.'s tender apart from the question of price. The deputy city electrical engineer submitted an analysis of the two remaining competing tenders. Differences in spares, foundation work, &c., had to be considered, and, taking these on a comparative basis, the full tenders worked out as follows :—A.E.G. Co., £12,180 ; Maschinenfabrik Oerlikon, £12,629 ; a difference of £449 in favour of the A.E.G. As against this, the Commintee had to consider the following points on the tenders set out in the engineer's report :—

1. That the specified speed of the Oerlikon turbine is 1,545 R.P.M., as against 3,090 R.P.M. of the A.E.G. machine, a very distinct advantage in favour of the Oerlikon Co.'s plant, and one that would mean a substantial difference in the price if the A.E.G. set were speeded at the same rate as that of the Oerlikon Co., which latter was the speed set down in the Committee's specification.
2. The steam consumption guaranteed shows a very distinct difference in favour of the Oerlikon Co., and the deputy city electrical engineer having worked out the difference taking it at an equivalent of 1,500 hours' annual full-load running, reported that it meant a saving by the Oerlikon set of not less than £70 per annum.
3. The Committee also considers that it is an important advantage, representing a substantial value in money, that they should have the two 3,000-KW. sets of exactly the same type, as, apart from the advantage to the staff, an important saving would be effected by the requirement of only one stock of spare parts instead of two.

These three considerations, in the opinion of the Committee, work out at far greater money value than the difference of £449 between the two tenders, and having regard to the extremely satisfactory manner in which the set of plant installed by the Oerlikon Co. last year has worked, the Committee recommends their tender for acceptance as giving the best value.

Italy.—La Societa Ferrovie Elettriche di Catane, of Catania, has placed a contract with the Societé des Ateliers de Constructions Electriques de Charleroi (Belgium) for the supply of 25 railway carriage underframes with motors of 32 H.P., 37 H.P. and 40 H.P. and three 200-KW. dynamos, a battery of accumulators and a switchboard.

London.—L.C.C.—The contract for electric lighting in connection with the rebuilding of the Ricardo Street School is being given to Messrs. Tilley Bros., at £378.

The following tenders were received for the electric lighting of the Strand School, now erecting at Norwood :—

Tilley Bros. (recommended)	£620	Pinching & Walton	£671
G. Weston & Sons, Ltd.	650	E. Lawrance & Sons, Ltd.	680
Tredegar & Co.	667	Templin & Makovski	975
Engineer's estimate	£695		

Tenders were recently invited from six selected firms for the repair of a 500-KW. D.C. armature at Clapham sub-station. Only two complete tenders were received, and both were unsatisfactory. The Committee now proposes that the machine be repaired by the makers, Messrs. Dick, Kerr & Co., Ltd.

The Electric and Ordnance Accessories Co., Ltd., have received an order from the Westminster Electric Supply Corporation, Ltd., for 50 "Eclipse" cookers of a new pattern, these cookers being intended for hiring-out purposes. We understand that designs were submitted by a number of other cooker manufacturers, and that the contract was placed after severe tests.

The Metropolitan Asylums Board has accepted the tender of Messrs. Chesher, Toy & Winslow, at £42, for electric lighting works at the Fountain Temporary Asylum.

MARYLEBONE.—The tender of Messrs. Blackmore & Co., for 4,000 tons of coal, at 15s. per ton, and 8,000 tons, at 14s. 1½d. per ton, f.a.s., has been accepted by the B.C. Electricity Committee.

New Zealand.—The following list of accepted tenders for material in connection with the Lake Coleridge Power Scheme appears in the *Australian Mining Standard* :—

Pipe line and accessories, £17,624 ; valves and accessories, £837.—Dunedin Engineering and Steel Co.
Water-wheels and accessories, £4,195.—Australian Metal Co.
Generators and accessories, £5,972.—Grey Thorne George, Auckland.
Transformers, £9,673 ; lightning arresters, £2,588 ; transmission insulators, £3,795.—National Electrical and Engineering Co., Dunedin.
Bare conductors, £13,101.—Richardson, Blair & McCabe, Wellington.
Insulated cables, £3,765.—P. R. Baillie & Co., Wellington.
Distributing insulators, £668.—Samuel Brown, Ltd., Wellington.
Testing transformers, £525.—Turnbull & Jones, Ltd.
Meters, £292.—A. & T. Burt.
Travelling crane, £646.—F. S. Greenshields & Co., Wellington.
Batteries and accessories, £840.—Turnbull & Jones, Ltd.
Bitumen, £1,087.—Neuchatel Asphalte Co.
Motor lorries, £1,106.—Grapes & Riley.
Motor-cars, £962.—Dalgety & Co., Ltd.
Gates for tunnel and penstock, £1,336.—Richardson, Blair & McCabe.

South Africa.—The *South African Mining Journal* states that an order has been placed for two variable-speed electric winders of the "Cascade" type, for the underground workings of the Van Ryn Deep, Ltd. The order has been placed with the Sandycroft Foundry Co., Ltd., of Chester. Their normal output will be 700 B.H.P. each, and their two efficient speeds are in the ratio of 2 : 3. These winders will be the first of the variable-speed "Cascade" type installed on the Rand.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION)

Commanding Officer—LIEUT.-COL. H. M. LEAF.

The following orders have been issued for the current week :—

Monday, December 9th.—"A" Company. Company training, 7 to 10 p.m.
Tuesday, December 10th.—"B" Company. Recruit training, 7 to 10 p.m.; company training, 7 to 10 p.m.
Thursday, December 12th.—"C" Company. Company training, 7 to 10 p.m.
Friday, December 13th.—"D" Company. Recruit training, 7 to 10 p.m.; company training, 7 to 10 p.m.
Saturday, December 14th.—"C" Company. Run at Fort Coalhouse. Parade at Fenchurch Street Station at 8 p.m. Dress: Service dress, putties and greatcoat. Headquarters will be open from 10 a.m. till 12 noon for regimental business only.

(Signed) P. H. CAMPBELL, Capt. R.E., and Adjt.,
For Officer commanding L.E.E.

Gifts to Liverpool University.—The Vice-Chancellor's report, presented at the annual meeting of the Court and Senate of the Liverpool University, on Saturday, November 30th, acknowledged the following gifts to the Department of Applied Electricity :—Sandycroft Foundry Co., Ltd., 10-H.P. cascade induction motor ; Dr. G. G. Stopford Taylor, 8-plate Wimshurst machine ; British Insulated and Helsby Cables, Ltd., a number of signalling instruments and telephone apparatus ; Campbell & Isherwood, Ltd., specimen resistance grids and stampings ; Crompton & Co., Ltd., set of working drawings and a four-machine set ; John Gibbs & Son, Liverpool, electrically-driven high-pressure fan.

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ELECTRICITY AT THE SHELTON IRON CO.'S WORKS.

The properties of the Shelton Iron, Steel and Coal Co., Ltd., of Stoke-on-Trent, are of considerable extent, and include mines, collieries, coke ovens, blast furnaces and rolling mills. The main works are situated at Etruria, and the auxiliary works, including a forge, at Shelton. Some idea of the size of the company's premises may be gathered from the fact that the view, fig. 8, shows but a corner of the Etruria Works, the complete electrification of which is being gradually carried out. The most recent development in the progress of the electrification of the plant will be reviewed in the present article.

Fig. 1.—Turbine Power House, Shelton Co.'s Etruria Works.

The Shelton works contain a forge and four mills, namely, a sheet mill, and 16-in., 12-in. and 10-in. mills. These, together with much of the auxiliary machinery used in connection with them—such as saws, shears, and the like, were, until recently, steam-driven, the steam being generated by 14 Lancashire boilers. Nine of these boilers used waste heat from the heating furnaces, but the remaining five were hand-fired. By dispensing with these boilers and substituting electric drives for two of the smaller mills and the auxiliary machinery, it was estimated that a considerable financial benefit would result, provided that the electricity could be generated by a prime mover deriving its motive power from some other source of waste heat. This was available in the exhaust steam from the reversing rolling-mill engines at Etruria, the use of which presented the following favourable conditions:—(*a*) Ample supply of otherwise wasted heat; (*b*) Demand for current, justifying the installation of a good-sized unit; (*c*) Good load factor; (*d*) Displacement of inefficient rolling mill engines; (*e*) Displacement of extremely wasteful steam drives on auxiliary machinery; (*f*) Displacement of hand-fired boilers with their attendant labour and occupancy of valuable ground space.

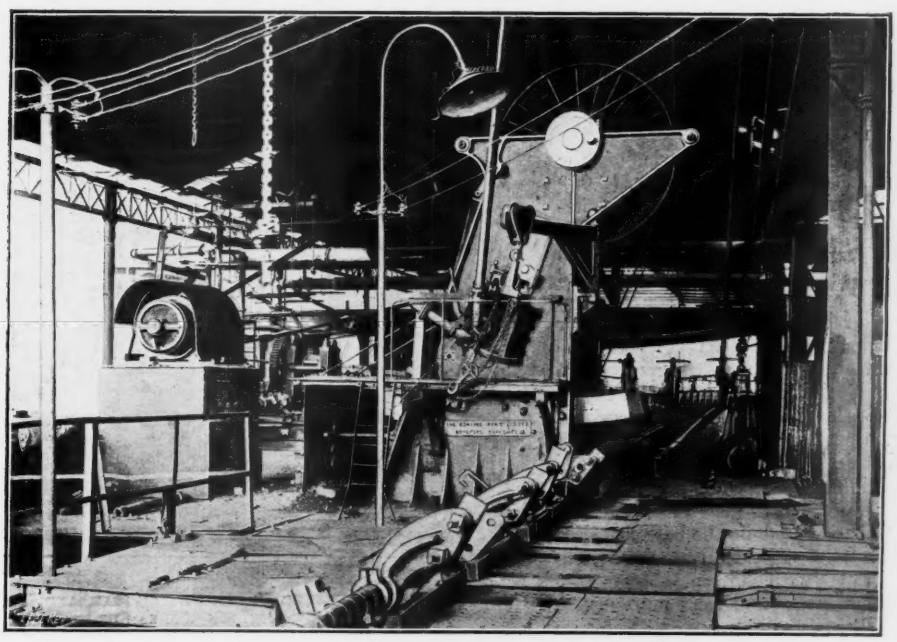

Fig. 2.—Motor-driven Hot Saw, &c., Shelton Iron Works.

Natural corollaries to conditions (*b*) and (*c*) were that the capital cost per kilowatt, and the cost per kilowatt generated, were both reduced to a minimum.

The reversing engines driving the 32-in. mill at Etruria are twin cylinder simple non-condensing machines, the cogging engine having 42 in. × 60 in., and the finishing engine, 50 in. × 60 in. cylinders. These engines are supplied with steam at about 120 lb. per sq. in. pressure, and 120° superheat, by nine Lancashire boilers, seven of which are hand fired, the other two using the waste heat from the heating furnaces. These engines exhaust into a riveted steel main, which also receives the exhaust from four small auxiliary engines. The whole of the exhaust steam is passed through a grease separator, and is thence conveyed to the power station by a 36-in. riveted steel pipe, carried over the stock banks and canal, as shown in fig. 1, which is an exterior view of the power station.

The exhaust steam pipe leads to an accumulator constructed to the design of Mr. P. J. Mitchell, one end of it being visible in fig. 1. This accumulator is capable of supplying steam to the turbine when running at full load, for periods of one minute, during which there is a cessation in the supply of exhaust steam from the mill engines. Steam from the accumulator is supplied to a Wright's heater-softener through a control valve which maintains a very slight pressure in the heater. Part of the boiler feed water is taken from the circulating water system through the heater softener, the remainder being discharged from the surface condenser as distilled water.

Since the supply of exhaust steam from the mill engines

is very erratic, it often happens that the full demand of the turbine and the capacity of the accumulator are exceeded, when the steam would blow to waste. As much use as possible has been made of this excess in the plant under review, some of the surplus steam being utilised to heat the feed water. Two tanks (shown in fig. 1 with conical tops) are provided, each with a capacity of 650 gallons. The water for the boilers is taken from the condenser circulating water, and passed through these tanks in series on its way to the heater softener. Into each of these tanks is taken a pipe from the accumulator, perforations being drilled in these pipes at such a level below the water in the tanks that the pressure due to the head of water above the perforations is just exceeded by that at which the relief valve on the accumulator itself is raised. Thus, the water in the tanks is thoroughly heated at each peak in the exhaust steam supply, whilst, at the same time, the call for live steam for heating purposes is much reduced. The actual temperature of the water at the feed pumps, maintained by these means, varies between 190 and 200° F., the boilers and pumps being situated across the canal at some distance from the heater.

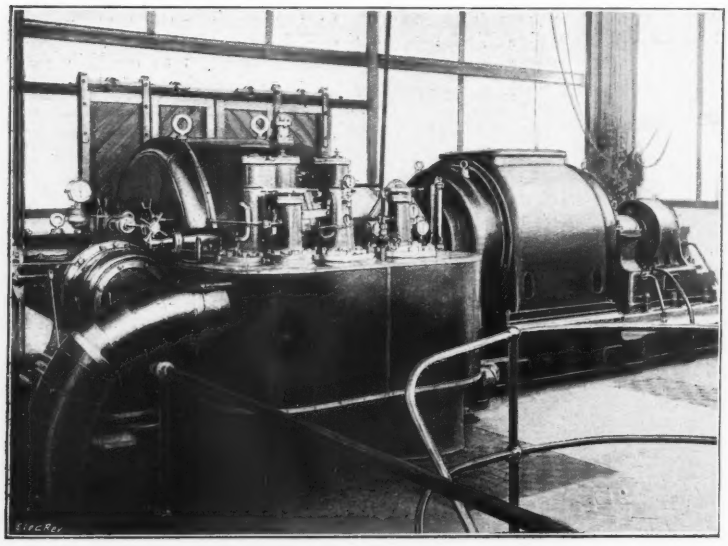

Fig. 3.—Westinghouse Turbine Plant in the Power Station.

Fig. 3 shows the inside of the power house and the 1,000-kw. (3,000 r.p.m.) mixed-pressure Westinghouse impulse-type turbine, driving a three-phase 50-cycle 5,500-volt pipe-ventilated alternator, with a direct-connected exciter having a radial commutator. The alternator is fitted with muslin air filters, arranged so that one can be cleaned whilst the other remains in use. The generator supplies current to the 8-panel black enamelled slate switchboard through a three-core, paper-insulated double-armoured cable. The voltage is kept steady by a Tirrill regulator. The high-tension switchgear is contained in cubicles located in the basement, and is mechanically operated from the switchboard in the turbine room.

The various 500-volt d.c. motors in the Etruria works are supplied with current from a 610-kw. 5,500/500-550-volt transformer, and a 500-kw., 750-r.p.m., 500-volt rotary converter, both of which are illustrated in fig. 9. The rotary is provided with an exciter and a.c. booster mounted on the same shaft. The current from the rotary is controlled from the low-tension panels of the main switchboard, whence it is distributed to the various motors in the Etruria works by overhead transmission lines.

The high-tension alternating current is transmitted to a sub-station at the Shelton works, over a three-phase transmission line composed of bare stranded aluminium conductors of ·2 sq. in. area, supported by creosoted timber poles; the terminals poles are steel structures, and the wires are prevented from falling to the ground by galvanised steel-wire cradling. Multiple gap lightning arresters are provided at each end of the line.

The condenser is of the Leblanc surface type, and has a cooling surface of 5,500 sq. ft. An Allen centrifugal pump is driven by a 72-b.h.p. Westinghouse motor at 600 r.p.m., and circulates the condensing water through the condenser and over the Zylba natural draught cooling tower, shown to the left in fig. 1. The condenser dry-vacuum pump is of the Leblanc rotary valveless type, and is driven by a 24-h.p. motor at 720 r.p.m. These pumps with their motors are illustrated in fig. 10, the condenser being situated through the wall at the right. The pump motors are controlled by Westinghouse Admiralty type control pillars.

The Westinghouse motors installed at the Etruria works are of various types and sizes, and perform many arduous duties, including the driving of the feed rolls, skids, and raising gear appertaining to the 32-in. mill, the main engines of which supply the steam for the mixed pressure turbine. Other motors are applied to the driving of saws, cranes, drills, shears, pumps, &c. Fig. 2 is a view looking towards the finishing rolls of this mill, the rolls being visible in the background. The finished stock is fed from the rolls through the channel way on to the rollers in the foreground, driven by 30-b.h.p. railway type motors, whence it is transferred by skids along the rails away to the right to cool. The motors employed on the mill feed rolls are 60-b.h.p. railway type machines and are located beneath the mill floor. This location is hot and dusty, so that totally enclosed machines had of necessity to be used, whilst the duty is extremely rough. The screwing down gear for the cogging rolls is driven by a 55-b.h.p. motor, and that for the intermediate rolls, by a railway type motor of 31 b.h.p. situated on a gallery between these stands of rolls. The skids for transferring the material from the cogging to the inter-

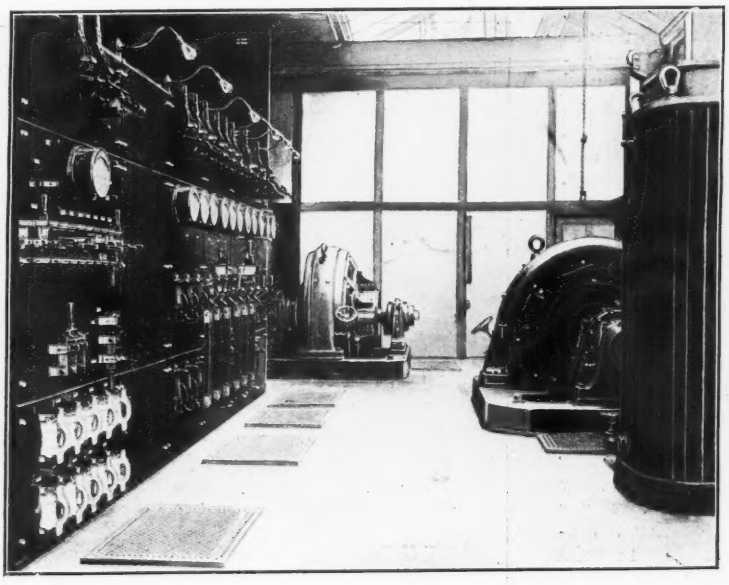

Fig. 4.—Converter Plant, Switchgear, and Mill Motor in the Shelton Works Sub-station.

mediate, and from the intermediate to the finishing rolls, are also motor-driven.

As the finished stock is fed from the channel way shown in fig. 2, it is cut off to the desired lengths by the Bowling saw illustrated. This saw is driven by a 55-H P. Westinghouse motor shown on the left. The saw was originally a steam-driven machine, the cylinders, crank, disk, steam pipes and driver's platform being clearly visible. The displacement of this gear naturally results in great savings since apart from the steam leaks which always occur in pipe work of this description the efficiency of such an engine is extremely poor.

Fig. 7 illustrates a girder-straightening press, driven by a 24-H.P. motor. This machine is situated at the stock bank, and any finished stock which deviates from the straight after passing through the finishing rolls, is brought to it to be corrected. It will be seen that the motor drives on to the fly-wheel shaft of the press by means of a belt, and it will be recogised that the duty must often impose very heavy momentary overloads on the motor. In the background, to the right, will be seen the power station, cooling tower, high-pressure steam pipe and the feed-water pipe beneath it.

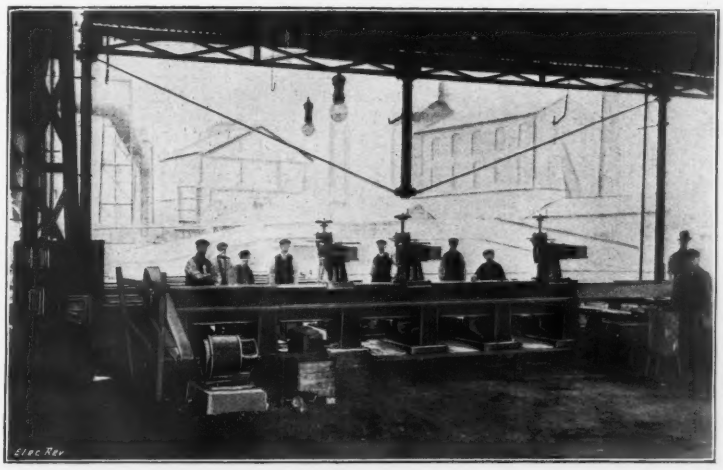

Fig. 5.—Girder Drill Press, with Westinghouse Motor Drive.

In fig. 5 a 13-B.H.P. motor running at 1,470 R.P.M. is is shown driving a Craven three-spindle girder drill press through a belt reduction. The motor control gear is mounted on the pillar at the left of the view.

The coal for the coking plant is brought to a washing house from the pits and is washed and screened, the dirt being carried away on an aerial ropeway. This is about

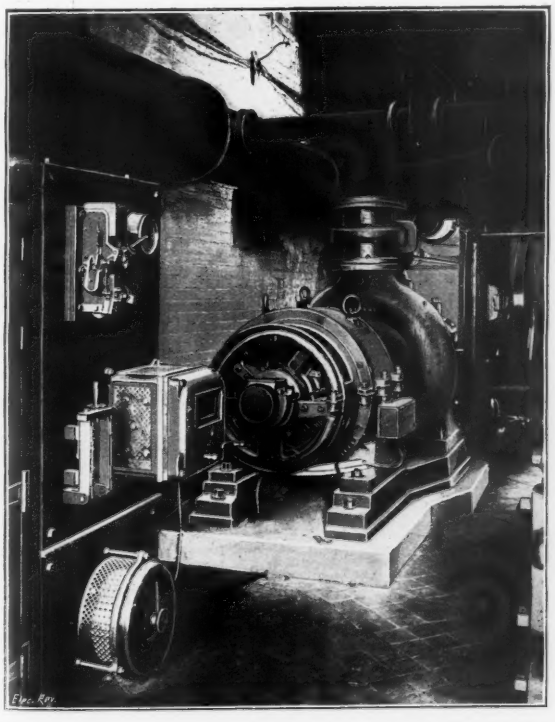

Fig. 6.—72-B.H.P. Electrical Pump and Switchgear.

¼ mile long, and carries 10 skips, which are automatically emptied on to a tip at the point required. The motive power for this conveying equipment is an 8-H.P. motor, which is situated in the cabin on the loading platform at the washing house. The washing house is capable of handling 500 tons of coal per working day of 10 hours, and supplies the coke ovens shown in fig. 8. Here the coking process is carried on, the coke-oven gas being used to advantage in a gas engine-driven electric power plant, the jacket water-cooling tower and gas-holders of which are to be seen beyond the near end of the coking plant. The gas is washed, and forced through coolers, tar extractors and purifiers by two Bryan-Donkin rotary blowers, driven at 95 R.P.M., through double reduction gearing made by the Power Plant Co. These blowers are driven by two 20-H.P. Westinghouse motors running at 600 R.P.M.

Some of the blast furnaces may be seen in the background of fig. 8, a boiler plant being located close by them, and using the furnace gas for fuel.

The hydraulic plant at the blast furnaces is a mixed equipment embodying steam pumps of all types, sizes and ages, and there is also a turbine-driven centrifugal blower. The latest addition to the hydraulic plant equipment is a Mather & Platt centrifugal pump driven by a 72-B.H.P. compound-wound motor, running at between 600 and 1,000 R.P.M. This pumping set is illustrated in fig. 6, in which view the motor control panel can also be seen. The refuse from an old forge tip which is being worked, is discharged at the Etruria end of the property, the

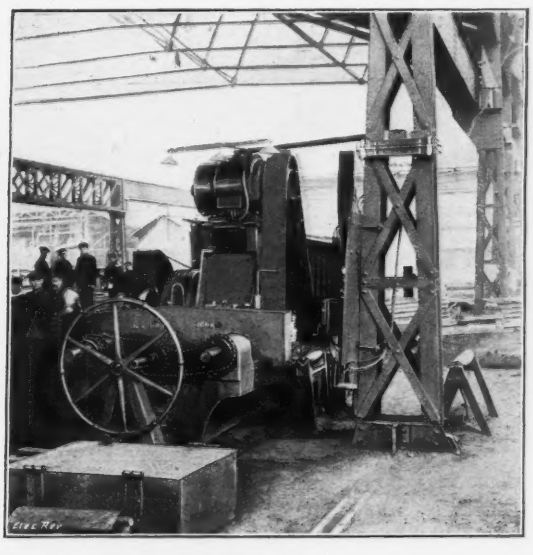

Fig. 7.—Girder Straightening Press, with Motor.

tip wagons being hauled by an endless cable receiving its motion from a 20-H.P. motor. This motor drives through reduction gear to a drum, around which the haulage cable is taken. The slack in the cable is taken up by a weighted bogie carrying a sheave and running on inclined rails.

At the Shelton works a sub-station receives the incoming three-phase, 50-cycle, 5,500-volt lines from the power

house, fig. 4 being an interior view of the sub-station. The feeder cables are taken to a seven-panel switchboard, from which connections are made through a 500-KW. 5,500/550-500-volt step-down transformer to a 500-KW. 500-volt compound-wound rotary converter running at 750 R.P.M., the rotary being provided with a liquid starter for starting up from the D.C. side. The shaft of the rotary is similar to that of the machine at the power station,

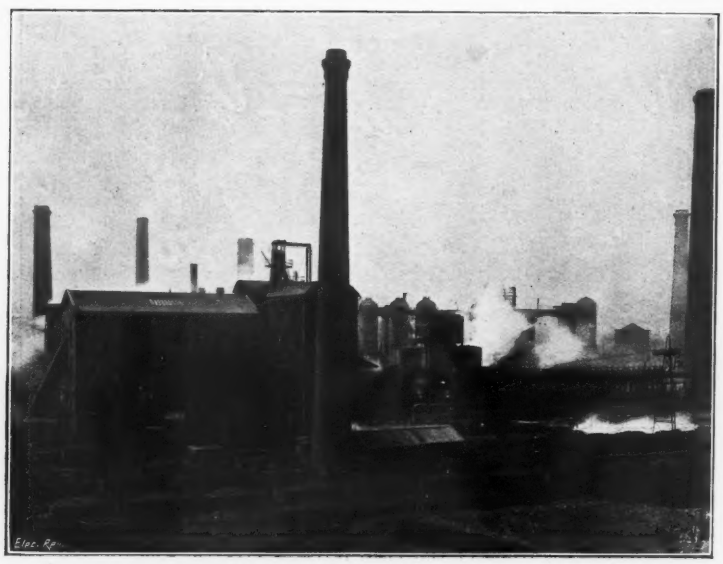

FIG. 8.—PART OF THE SHELTON CO.'S ETRURIA WORKS, SHOWING COAL WASHERY, AERIAL ROPEWAY, &C.

but the booster and exciter mounted on the shaft of the latter are omitted in the case of the sub-station rotary, the rotor of this machine being designed so that the rotor of the power house converter can be put in its place in case of a breakdown. This rotary is capable of carrying a 25 per cent. overload for two hours, and usually runs from Monday morning to Saturday afternoon without a stop.

At the far end of the sub-station is a 350-B.H.P. 500-volt, 450 to 720 R.P.M. compound-wound variable speed D.C. motor which drives the 10-in. mill. The motor shaft is provided with three bearings, a 3 ft. 6 in. rope pulley

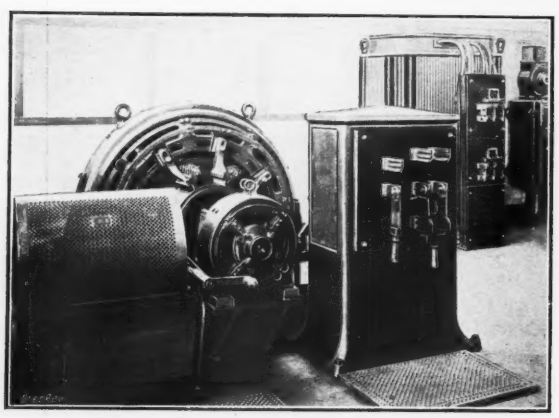

FIG. 9.—CONVERTER PLANT IN POWER STATION.

being mounted on it to carry 12 $1\frac{3}{8}$-in. cotton ropes. A liquid starter is provided for the motor, the starting handle being visible on the wall between the motor and the rotary, and the speed is variable by a shunt field rheostat. The starter itself is located outside the building. The motor will take an overload of 25 per cent. for one hour, and of 100 per cent. momentarily.

The rope fly-wheel of the 10-in mill is 10 ft. 6 in. in diameter and weighs 10 tons, the speed varying from 150 to 240 R.P.M. The mill has two stands of three high, and two stands of two high rolls, and produces chiefly light stock and notched steel bars, such as are used in ferro-concrete work. The rope drive is completely shut off from the interior of the sub-station by steel plate guards, so that none of the fluffy matter from the cotton ropes can get into the motor windings. The power required to run the 10-in. mill light is 50 to 90 KW.

The motor driving the 12-in. mill is similar in every respect to the above machine, except that it is fitted with a 36-in. pulley. This drives the crankshaft of the displaced engine by 12 ropes, the rope pulley on the engine crankshaft being 14 ft. 6 in. in diameter, and weighing 7 tons. The engine fly-wheel is left in place and weighs 15 tons, all that is disconnected being the connecting rod big end and the eccentric strap. The engine shaft is driven at 90 to 150 R.P.M., and operates one stand of three high bolting rolls, and one stand of finishing rolls which may be worked either two or three high.

The power required to run the 12-in. mill light is 43 to 80 KW.

The adoption of the rope drive, more particularly in the case of the 10-in. mill, may appear to be open to criticism. It should, however, be noted that the high speed of the motor keeps down the cost of the equipment, whilst the two motors are exactly interchangeable, except for the pulleys, and the previous arrangement of both mills was extremely favourable for the rope drives. The motors, whilst they are in no way too large for the work, have proved of ample power and have operated satisfactorily in every respect.

There are a number of small Westinghouse motors scattered about the Shelton works, operating on the 500-volt D.C. circuit. These motors replace steam drives in the majority of cases in which they are applied to such machines as saws, shears, hoists and pumps.

The cost figures per unit of electricity generated, over a

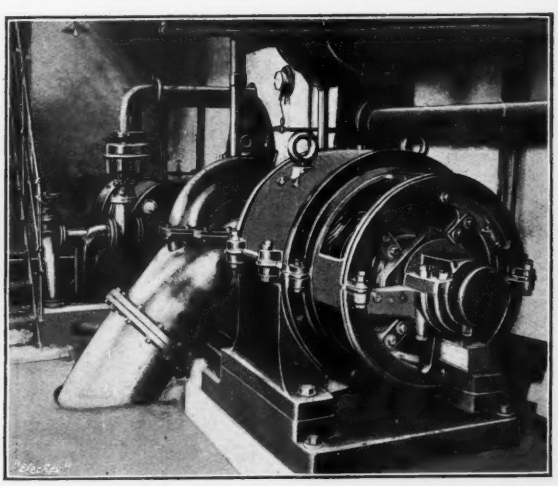

FIG. 10.—WESTINGHOUSE CONDENSER PUMPS IN POWER HOUSE.

period of six months working, are as follows :—Wages, ·0331d.; stores, ·0137d.; fuel, ·0638d.; repairs, nil; total, ·1106d. These figures are exclusive of interest on capital charges and depreciation. The cost for fuel is based on the average time which the turbine ran on live steam alone. The total number of units generated in this period was 2,090,000, so that the operating costs for the 1,000-KW. set may be taken at being approximately £1,926·66 per annum.

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FORTHCOMING EVENTS.

Northampton Polytechnic Institute, St. John Street, E.C.—Friday, December 6th. At 7.30 p.m. Distribution of prizes and certificates by the Marquess of Northampton.
Saturday, December 7th.—From 6.30 p.m. to 11 p.m. Members' and Students' annual conversazione.

Royal Society of Arts.—Monday, December 9th. At 8 p.m. Cantor lecture on "Methods of Economising Heat," by Mr. C. R. Darling. Lecture II.
Wednesday, December 11th.—At 8 p.m. Paper on "Natural and Synthetic Rubber," by Dr. F. W. Mollwo Perkin.

Institution of Mechanical Engineers (Graduates' Association).—Monday, December 9th. At 8 p.m. Paper on "The New Generating Plant for the Port of Calcutta," by Mr. C. E. Robertson.

Institution of Electrical Engineers (Newcastle Section).—Monday, December 9th. At 7.30 p.m. At the Armstrong College, Newcastle. Paper on "Earthed *v.* Unearthed Neutrals in A.C. System," by Mr. J. S. Peck.
Wednesday, December 11th.—At 7 p.m. At the Lit. and Phil. Society's Rooms, Middlesbrough. Paper as above.

Institution of Electrical Engineers (Western Section).—Monday, December 9th. At the Merchant Venturers' Hall, Bristol. Meeting.

Institution of Post Office Electrical Engineers (Metropolitan Centre).—Monday, December 9th. At 6 p.m. At the I.E.E., Embankment, W.C. Paper on "Wireless," by Mr. F. Addey.

Faraday Society.—Tuesday, December 10th. At 6.30 p.m. Dinner at the Holborn Restaurant. At 8 p.m., at the I.E.E. Lecture on "The Electro-Motive Forces of Concentration Cells," by Principal A. P. Laurie.

Institution of Civil Engineers.—Tuesday, December 10th. At 8 p.m. Paper on "The Distribution of Producer Gas in South Staffordshire," by Mr. H. A. Humphrey.

Institution of Electrical Engineers (Manchester Students' Section).—Tuesday, December 10th. At 7.30 p.m. At the Municipal School of Technology, Manchester. Paper on "Electric Theatre Installations," by Mr. S Burns.

Institution of Electrical Engineers (Scottish Section).—Tuesday, December 10th. At 8 p.m. Meeting at the Princes Street Station Hotel, Edinburgh.

Association of Engineers-in-Charge.—Wednesday, December 11th. At 8 p.m. At St. Bride's Institute, E.C. Paper on "Modern Methods of Electric Wiring," by Mr. F. Broadbent.

Junior Institution of Engineers.—Wednesday, December 11th. At 8 p.m. Presidential address, "Staff Officers in Industrial Works: Their Scientific and Practical Training and Duties," by Sir A. Trevor Dawson, R.N.
Saturday, December 14th.—At 7 p.m. At Caxton Hall, Westminster, S.W. Reception, dance and whist drive.

The Dynamicables.—Wednesday, December 11th. At the Hotel Cecil. Dinner.

Institution of Electrical Engineers (London).—Thursday, December 12th. At 8 p.m. Paper on "A Single-phase Motor with Pole-changing Windings," by Mr. B. P. Haigh.

Institution of Electrical Engineers (Dublin Section).—Thursday, December 12th. At 8 p.m. Meeting at the Royal College of Science, Dublin.

Electro-Harmonic Society.—Friday, December 13th. At 8 p.m. At the Holborn Restaurant. Smoking concert.

Institution of Electrical Engineers (Students' Section).—Saturday, December 14th. At 7, for 7.30 p.m. At the Trocadero Restaurant, Piccadilly Circus, W. Annual dinner.

NOTES.

Institution and Lecture Notes.—INSTITUTION OF ELECTRICAL ENGINEERS (DUBLIN LOCAL SECTION).—At the meeting on November 14th, Prof. W. Brown gave an account of the equipment of the electrotechnological laboratories of the Royal College of Science, Dublin. The switchboard consists of marble panels, and is 40 ft. in length. There are 18 machines, by various British makers, the largest being a 30-KW. dynamo and a 46-H.P. induction motor; six smaller machines are also provided, as well as transformers and a storage battery. The testing apparatus includes an oscillograph, potentiometer, &c., and provision is made for experiments on electric furnaces and high-pressure work.

INSTITUTION OF ELECTRICAL ENGINEERS (NEWCASTLE LOCAL STUDENTS' SECTION).—On November 25th Mr. P. Grice read a paper on "The Heating and Cooling of Electrical Machinery," outlining the theory and illustrating the use of the heating time constant in deducing information as to the behaviour of a machine under various conditions. The inefficiency of radial ducts in armature cores was pointed out, and the bad effect of air pockets in field coils. The use of artificial methods of cooling with air and water was also discussed.

INSTITUTION OF ELECTRICAL ENGINEERS (WESTERN SECTION).—A neat pamphlet has been issued containing the names of the officers and Committee of the Section, extracts from the articles of association and the rules of the Local Sections, and a list of members.

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER SECTION).—A meeting was held on Tuesday, December 3rd, when a paper was read by Messrs. J. G. and R. G. Cunliffe on "Some Problems in Traction Development—Tramway Feeding Networks." A long and interesting discussion followed, which was replied to by the authors.

INSTITUTION OF ELECTRICAL ENGINEERS (MANCHESTER STUDENTS' SECTION).—At a meeting on Tuesday last week Mr. S. N. C. K. Whitehead read a paper on "The Individual Electric Drive in a Modern Weaving Shed."

PHYSICAL SOCIETY OF LONDON.—The eighth annual exhibition of apparatus will be held by the Physical Society on Tuesday, December 17th, at the Imperial College of Science and Technology, South Kensington, from 3 to 6 p.m., and from 7 to 10 p.m.

SOCIETY OF ENGINEERS (INC.).—On December 2nd, Mr. P. J. Waldram read a paper on "Test Deflections in Reinforced Concrete."

ROYAL SCOTTISH SOCIETY OF ARTS.—At a meeting in Edinburgh last week, Mr. G. A. Dickie, Birkenhead, gave a description of "A Miner's Electric Safety Lamp," the invention of the author.

INSTITUTE OF METALS.—The annual general meeting of the Institute will take place on March 11th and 12th, 1913, at Storey's Gate, Westminster. Amongst the papers that will be presented will be Dr. G. D. Bengough's Second Report to the Corrosion Committee, in which he will deal with the results obtained from the experimental condenser which has been running continuously at Liverpool since the beginning of April. A ballot for the election of new members will take place this month; applicants for membership should send in their forms to the secretary on or before December 16th. As a result of a suggestion contained in a paper on "The Nomenclature of Alloys," read by Dr. W. Rosenhain before the Institute in January last, a Committee consisting of representatives of the Institute of Metals and Allied Societies has been appointed under the name of the Nomenclature Committee, and will shortly hold its first meeting.

ROYAL INSTITUTION.—The following are among the lecture arrangements before Easter:—Prof. Sir James Dewar, Fullerian Professor of Chemistry, a course of six experimentally illustrated lectures, adapted to a juvenile auditory, on Christmas lecture epilogues: Alchemy, December 28th; Atoms, December 31st; Light, January 2nd; Clouds, January 4th; Meteorites, January 7th; Frozen Worlds, January 9th. Prof. B. Hopkinson, two lectures on Recent Research on the Gas Engine. Prof. Sir J. J. Thomson, Professor of Natural Philosophy, six lectures on the Properties and Constitution of the Atom. The Friday evening meetings will commence on January 17th, when Prof. Sir J. J. Thomson will deliver a Discourse on Further Applications of the Method of Positive Rays.

BIRMINGHAM ASSOCIATION OF MECHANICAL ENGINEERS.—On November 2nd a paper on "Electric Lighting Systems and Dynamos for Motor-Cars" was read by Messrs. J. T. Walton and A. E. Brewerton, who recommended the use of a battery in conjunction with a dynamo driven from the main engine, and described the principal systems in use. An extra meeting was held on November 21st, when Mr. R. Berry read a paper on the "Transmission of Power by Belting."

ASSOCIATION OF MINING ELECTRICAL ENGINEERS.—At a meeting last Saturday at Nottingham, Mr. E. E. Beadsmoore, of Tibshelf, submitted a paper on "A Distance Indicator for Underground Haulage Signals.

ASSOCIATION OF MINING ELECTRICAL ENGINEERS (EAST OF SCOTLAND BRANCH).—The following are the dates and places of meeting for the remainder of the 1912-13 session:—December 20th, Kirkcaldy; January 24th, 1913, Dunfermline; February 22nd, Edinburgh; March 28th, Dunfermline; April 25th, Kirkcaldy; May 16th, Dunfermline.

At a recent meeting of the Croydon and District Launderers' Association, Mr. A. C. Bostel, of the Croydon Corporation Electricity Works, gave a lecture on "The Uses of Electricity in the Laundry."

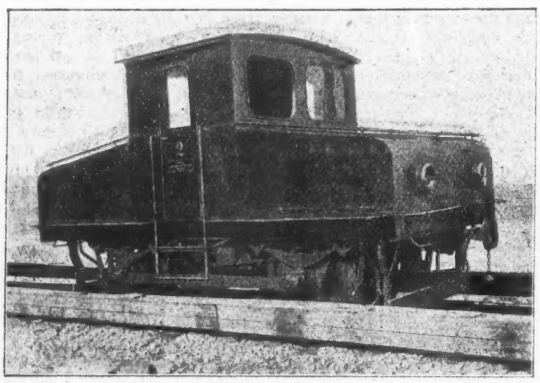
Horizontal Aerials.—The possibility of using horizontal in place of vertical antennæ is of special interest, in that the construction of the former is simpler and cheaper. Provided account is taken of the special properties of horizontal aerials, the latter are at least as satisfactory as the vertical type as regards both reception and transmission.

M. Turpain has recently conducted experiments on a large scale at St. Benoit (Morocco), and communicated his results to the Assocn. pour l'Avancement des Sciences, at the Nimes Congress. Three horizontal wires, each 400 m. in length, were arranged parallel to each other at a distance of 25 cm., and arrangements were made for their interconnection in various manners. The lowest wire was 10 m. from the ground, and thorough earth connection was effected by two square zinc plates (40 cm. side) immersed in a pond.

When using only one of the horizontal aerials, signals from Rochefort, Brest, and Bizerta, were received, as well as those from two more distant, unidentified stations—one of which was believed to be Poldhu. Using a crystal detector, the Eiffel Tower time signals could be distinctly heard when the telephone was 26 cm. from the ear. Using three aerials in parallel, the latter distance could be increased to 33 cm. before the signals became inaudible. Very satisfactory results were obtained with wires 200, 300 and 400 m. in length, stretched along dry ground, but reception was not nearly so good as with the former elevated aerials.

A 400-m. aerial suspended 10 m. above ground level was compared with a vertical aerial carried from a 22-m. mast, and presenting a total length of 148·5 m. In observing time signals on the same day and with the same detector, the signals ceased to be audible when the telephone was 12 cm. from the ear using the vertical aerial (the circuit being tuned in each case to give maximum sensitivity). It was also found that the effects of parasitic waves and atmospheric disturbances were less serious when the horizontal aerial was employed. The cost of the latter was about half that of the vertical aerial with which it was compared.

Electrical Locomotives at the Sydvaranger Mines in Norway.—For the transport of "slig" or fine iron ore and briquettes, the Sydvaranger Co. has built an electrical railway, which is the most northerly railway of its kind in the world. Two electrical locomotives have been constructed for this line, which are shown in the illustration. At the time when these locomotives were ordered there was some question that the regular supply of current would be affected by the heavy falls of snow which sometime occur in these latitudes, but these anticipations have happily not been verified during the two winter seasons that the line has been at work, and there has, as a matter of fact, only been a stoppage of two hours on account of snow. The compartment for the driver is as shown in the illustration, completely



closed, and all the controlling apparatus is arranged in such a way that the driver shall not be obliged to move from his place, even if the direction of running is reversed. The weight of each locomotive amounts to 11,000 kg., apart from which it also carries ballast of 6,000 kg., so as to obtain the necessary adhesion. Current is supplied to the locomotive by means of a third rail, and sliding shoes carried by the bearings of the engine.

The working of the line is arranged in the following order:—Every 45th minute there is run a train-load of 185 tons gross and about 100 tons net, distributed on four wagons. As every train has to be weighed and shunted under the loading bridge, these must be started every three-quarters of an hour as follows: Seven times with a loaded train; twice with an empty train; four times with the locomotive only.

Parliamentary Notes.—Oil and Electric Lamps (Testing).—Sir Arthur Markham asked the Home Secretary how the charge of £20 which he proposed to charge safety lamp manufacturers for testing oil and electric lamps, was made up. Mr. McKenna replied that the amount of the fee had been fixed so as to cover as nearly as possible the expenditure incurred by the Government in connection with the test, which includes the charges in respect of the establishment and equipment of the station, the working and maintenance expenses, and a proportionate part of the salaries of the officials employed on the work. It was not possible, in a matter of this kind, to make any close estimate, as the number of lamps likely to be submitted after the first year was uncertain, but he had no reason at present for thinking that the average annual amount received in fees was likely to show any surplus over expenditure.

Electrical Work on Battleships.—In the Parliamentary Papers last week, Mr. Barnes asked the First Lord of the Admiralty whether he was aware of a dispute in progress between Messrs. Beardmore, the Fairfield Shipbuilding Co., and Messrs. John Brown and Co., and the electricians in their employment; whether he was aware that the electrical work on H.M.S. *Conqueror*, H.M.S. *New Zealand*, H.M.S. *Southampton* and H.M.S. *Agasta* was being either inefficiently done by apprentices or neglected altogether: was the Admiralty passing the electrical work that had been or was being done on these ships, or what action was it taking; and whether he would inquire as to whether the employers were observing the fair-wages clause in their methods of dealing with the dispute. Dr. Macnamara replied that the Admiralty was aware of the existence of the dispute referred to, but, except in one case, no definite complaint in regard to the fair wages clause had been received at the Admiralty. Inquiries were being made into the circumstances of that case. Mr. Barnes could rest assured that none but satisfactory work would be accepted for H.M. ships.

Copper.—The returns for the end of November, as shown by Messrs. H. R. Merton's circular, do not indicate quite so brisk a market as would be expected. The difference in European visible supply (including Rotterdam and Hamburg stocks) is 3,060 tons. Withdrawals from English and French stocks are more in accordance with the recovery in trade now taking place, the English ports having transferred or sold 1,559 tons, and French 2,050, an unusually large decrease for the latter. Against this, the quantities afloat from Chile and Australia are rather heavier. Stocks in Rotterdam are entered as 350 tons only.

Turning to supplies, we find that North America is about average, Spain and Portugal considerably above, with 1,806 tons, Chile shipments below average, Australia shipments above. Total deliveries, at 41,828 tons, are good, but, as before remarked, not so high as might be expected.

The American Copper Producers' Association figures for American stocks (end of October) are 34,261 tons, an increase of 6,106 tons over the quantity for the end of September. The total visible supply for the end of October was 80,602 tons, an increase of 4,502 tons on the return for September 30th.

Manchester Electro-Harmonic Society.—The second concert of the above Society was held on Friday evening last, when a goodly number of members and visitors were present. The programme arranged was of a high-class nature, and nothing but praise can be given to the instrumentalists for the brilliant manner in which they rendered their selections. There was no question but that the items were very greatly enjoyed by those present. The singing of Mr. Bridge Peters was excellent, though his voice would have been heard to greater advantage in a larger room. The humorous selections given by Mr. Wilfred Ludlow were much appreciated. Mr. W. J. Smith, hon. musical director of the Society, is to be congratulated on arranging such a high-class programme, and it is to be hoped that he will be equally successful on the next occasion.

A correspondent writes:—"I was in Manchester last Friday and decided to stay for the Electro-Harmonic concert that evening. I found it so good that I feel impelled to tell my fellow members of *The* Electro-Harmonic Society (as our Manchester *confrères* ungrudgingly call it) all about it.

"The fear that I should feel an 'outsider' among so many people I did not know, was at once dispelled by the very hearty reception I had when it was known I was a member of *The* E.H. Society. The concert was timed for 7.15, though it did not actually start till 7.30—a still early hour for a Londoner—and left off at about 10.45, one or two curtailments having to be made in order to get through in time. The first thing I noticed on entering the room was the very splendid get up of the programmes, which are far more elaborate than our London ones. (This is not meant for an odious comparison, as I think we are all well satisfied with what we get.) The next striking feature, and one which struck me as worthy of emulation, was that the chairman, Mr. Cramp, announced that the waiters would take orders before the beginning of the first item and would execute them at the end of it. The absence of waiters, with their accompanying noise during the turns, was a very pleasing feature throughout the evening.

"But the best deviation of all from our practice in London was the number of intervals that were allowed between the turns. It has always seemed to me that there are not enough allowances for hob-nobbing at our London concerts, with the result that when one moves at half-time it is difficult to get back till the second half is nearly finished owing to the many acquaintances one meets. In Manchester, several five and 10-minute intervals are allowed and are much appreciated. Do our much larger audiences in London preclude this arrangement?

"The concert itself was tip-top. Too classical I am afraid for our London people, but much appreciated in Manchester, as was evidenced by the reception given to some remarks made by Mr. Smith, of Leigh and Bedford, in proposing a vote of thanks to the musical director. It was, to me, a novel sight to see the score of the music on the chairman's table, and to see with what relish it was followed by those around. Not that the comic element was not well received. In fact, as usual, the funny man elicited the most applause and got most encores. A very excellent baritone singer was the only other to get encored, encores not being a feature of the Manchester concerts, as they are in London. Of course, it is this self-restraint that allows time for the many intervals I have written of.

"Altogether it was a very pleasant evening, and reflects great credit on Mr. Hill, the secretary, and Mr. Smith, the musical director; my best thanks to them both for their kind welcome.

"In conclusion, I have to repeat the message that appeared in a former issue of this paper, viz., that all members of *The* Electro-Harmonic are cordially invited to 'show-up' at any of the Manchester Electro-Harmonics."

The Electro-Harmonic Society.—The next Smoking Concert will be held at the Holborn Restaurant (King's Hall) on Friday evening, December 13th, at 8 o'clock. The artistes are as follows: Vocalists—Mr. Edward Davies (tenor), Mr. Humphrey Bishop (baritone), Mr. Charles James (bass); Siffleur and humorist, Mr. Arthur Melrose; Irish comedian, Mr. Alfred Hurley; Humorist, Mr. Will Edwards; Banjo, Mr. Joseph Bull; Entertainer at the piano, Mr. Selwyn Driver. Solo pianoforte and accompanist, Mr. Bernard Flanders, A.R.A.M.

Canada.—According to H.M. Imperial Trade Correspondent at Toronto, a company has been formed in Ontario, with a capital of $1,000,000 (about £205,500), for the purpose of manufacturing and dealing in electrical and other machinery, generators, motors, dynamos, lamps and electrical devices and supplies of all kinds. The name can be obtained from the Board of Trade Commercial Intelligence Department in London.

The Sleeping Passenger.—A builder's labourer went to sleep in a tramcar on the night of August 26th, and he awoke to find himself in the car depôt. Picking his way out through the rails he fell into a pit and was injured. While holding that the servants of the Metropolitan Electric Tramways, Ltd., were negligent for not searching the car, the Marylebone County Court judge held that the plaintiff was equally to blame, and he gave judgment for the company.

The Electrical Trades Benevolent Institution.—The performance of "The Second Mrs. Tanqueray," given on October 16th by the Garrick Dramatic Society in aid of the funds of the Electrical Trades Benevolent Institution, was a success in every way. Not only did it provide, for those who were able to avail themselves of it, an opportunity for spending an enjoyable evening in the presence of a large company of kindred electrical spirits listening to an excellent rendering of the piece by talented members of the Society, but—and this is really the main consideration—it has brought from the Society out of the proceeds of the performance a donation of £50 for the Benevolent Fund. Thanks are due to the Garrick Society, to the members of the Benevolent Fund Committee and others who pushed the sale of the tickets, to electrical firms and individuals who bought them, and, of course, to Mr. Hawes, the secretary of the fund, for working so arduously to make a success of the event.

The Bradford Strike.—Our correspondent writes :—"The electricans' dispute at Bradford remains unsettled. The Lord Mayor's offer of arbitration has been refused by the employers, whilst the men did not greatly favour that course, and at a meeting of the Bradford Trades and Labour Council on Thursday last, it was stated that the men thought it desirable that a meeting of the workers engaged in the building and furnishing trades in Bradford should be convened to discuss the matter. It appeared that a large number of the electricians on strike were obtaining good employment outside Bradford, and if the period of waiting was prolonged the objects of the men might be defeated, for their strength locally was being seriously depleted owing to strikers getting fresh employment elsewhere. It was decided that the suggestion of the electricians should be carried out and a meeting of the builders and furnishers convened."

The B.E.A.M.A.—We are notified that the annual general meeting of the British Electrical and Allied Manufacturers' Association (Inc.) will be held in the Lecture Theatre of the Institution of Electrical Engineers, Victoria Embankment, W.C., on Friday, January 24th, 1913, at 2.30 p.m. The business will include the reading of the annual report and balance-sheet, and the election of five members of Council to fill retirements under the articles of association. The annual dinner of the Association will be held on the same day, the Right Hon. Lord Ampthill, G.C.I.E., &c., President of the Association, presiding. Details of arrangements for the annual dinner will be forthcoming shortly.

L.C.C. Coal Bill.—The annual maintenance votes for 1912-13 include a provision of £92,350 in respect of coal for use at the Greenwich generating station, but it is pointed out that owing to the high price of coal consequent on the coal strike, and to the necessity for burning a larger quantity than was estimated by reason of the breakdown of one of the larger turbine units, the vote will be exceeded by an estimated sum of £40,700.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials. — At the invitation of Ald. Joseph Clifton, chairman of the Peterborough Town Council Electricity Committee, the whole staff of the works sat down to dinner together last week. Interesting speeches were made by Mr. J. C. Gill, the city engineer, and other members of the party. In the course of the evening, Mr. T. Rowlands, works engineer, on behalf of the staff, presented Ald. Clifton with a large framed picture representing the exterior and interior of the works, various parts of the plant, the members of the staff and other details.

MR. C. MITTELHAUSEN, electrical engineer and tramway manager to the Bexley U.D.C., has resigned his position.

The marriage has taken place at St. Margaret's Church, Lowestoft, of MR. RALPH HARDY, assistant engineer at the Lowestoft Electricity Works, and Miss Margaret S. Dance, daughter of Mr. C. W. Dance, of Lowestoft. The presents included a large tantalus from the electrical staff.

The Ilford U.D.C. has appointed MR. GEORGE EDWARD WILLIAMS, of Finchley, as second charge engineer at the electricity works.

In consequence of the resignation of the second engineer-in-charge, MR. G. INGRAM, the Bermondsey Electricity Committee has decided to promote the third engineer-in-charge, MR. P. G. CAMPLING, to the vacant post, at £120 per annum, rising to £140. MR. C. J. OAKE, junior engineer-in-charge and switchboard attendant, is to be promoted to the position of third engineer-in-charge, at £110, rising to £130.

The staff at Colne electricity works has been re-arranged owing to resignations. MR. GEORGE CHADWICK has been promoted to the position of senior charge engineer.

MR. B. D'RANE has resigned his position as assistant mains engineer to the St. Marylebone electric supply, having obtained an appointment with the Para Electric Railways and Lighting Co., Brazil.

The Dudley Corporation Lighting Committee has passed a resolution recommending that MR. C. E. SAVAGE, electrical engineer, who has tendered his resignation, receive the thanks of the Council for the able manner in which he has conducted the working of the electric power station during his engagement.

MR. H. C. APPLEBY has resigned his position as senior shift engineer with the Kidderminster and District Electric Lighting and Traction Co., in order to take up the duties of shift engineer at the Rawtenstall Corporation Electricity Works.

General.—Upon his resignation as chief electrician at the Bentley Colliery, Doncaster, MR. BARBER has been the recipient of a handsome gold watch from the officials and employés of the colliery. Mr. Barber has obtained a post in India in connection with the construction of a railway there.

MR. T. J. MCKAVANAGH has resigned his position as chief electrician of the cs. *Minia*, and on December 1st he took up the duties of Lecturer and Demonstrator in Electrical Engineering at the Technical Institute, Shawinigan Falls, Quebec. He is equipping the electrical engineering laboratory, and will be glad to have lists from makers of laboratory supplies.

MR. CHARLES F. BENNETT has resigned the chairmanship of the Sheffield Corporation Electric Light Committee.

Four members of the Blackpool Tower electricity staff—MESSRS. JOHN BAMBER, SID. QUICK, CYRIL DAVIES and GEORGE NELSON—have left Blackpool for Sydney, New South Wales, to join Mr. C. Grundy and other old Tower employés who left Blackpool some weeks ago. Each of the "emigrants" received a memento from the Tower staff.

MR. J. D. TAYLOR, assistant superintending engineer of the engineering department of the Post Office, has been appointed superintending engineer, East District, Scotland.

MR. T. H. MATTHEWMAN, M.Eng., who graduated with honours in the Liverpool University, has been appointed Lecturer in Electrical Engineering at the University of Hong Kong. Mr. Matthewman had a distinguished career in Liverpool, holding a Senior City Scholarship as well as the David Rew Memorial Scholarship.

COUNCILLOR D. B. FOSTER, of Leeds, by trade an electrician, has just conducted a debate with Tom Mann, in the Leeds Albert Hall, on "Syndicalism."

NEW COMPANIES REGISTERED.

Farringdon Electric Light and Power Co., Ltd. (125,573).—This company was registered on November 27th, with a capital of £2 500 in £1 shares, to carry on the business indicated by the title, and to adopt an agreement with the Rural Districts Electric Undertaking, Ltd. The subscribers (with one share each) are:—H. T. Harrison, 11, Victoria Street, S.W., engineer; W. Riggs, 23, Davies Street, W., engineer; L. E. Jones, 29, Woodstock Avenue, Hendon, N.W., gentleman; H. U. Andrews, 54, New Broad Street, E.C., A.C.A.; H. T'Anson Jones, 62, London Wall, E.C., solicitor; W. G. C. Masham, 54, New Broad Street, E.C., secretary; Miss M. Fates, 77, Broadway, Bexley Heath. Minimum cash subscription, 100 shares. The first directors are H. T. Harrison, W. Riggs, O. H. Valpy, and J. Jacobs, J.P.; qualification, £50. Registered by T. J. Jones, 54, New Broad Street, E.C.

Metamica Syndicate, Ltd. (125,602).—This company was registered on November 28th, with a capital of £2,000 in £1 shares, to acquire from W. McLoughlin an invention relating to improvements in mica and the like insulators and screens, and to carry on the business of insulating material and electrical instrument manufacturers, &c. The subscribers (with one share each) are:—A. Round, 21, Waterloo Street, Birmingham, solicitor; C. F. Gloster, 21, Waterloo Street, Birmingham, solicitor. Private company. The number of directors is not to be more than five; the subscribers are to appoint the first; remuneration as fixed by the company. Registered office, 21, Waterloo Street, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Keighley Electrical Engineering Co., Ltd. (44,893).—Capital £10,000 in £1 shares (3,000 pref.). Return dated September 24th, 1912 (filed November 5th), 4,200 ord. and 1,800 pref. shares taken up; £1 per share called up on 2,588 ord. and 1,400 pref.; £3,988 paid; £2 012 considered as paid on 1,612 ord. and 400 pref. shares. Mortgages and charges: £5,000.

Cape Electric Tramways, Ltd. (54,636).—Capital £500,000 in £1 shares. Return dated November 13th, 1912; 491,002 shares taken up; £91,222 paid; £400,000 considered as paid. Mortgages and charges: £463,000.

Concordia Electric Wire Co., Ltd. (74,416).—Capital £2,000 in £1 shares. Return dated October 14th, 1912. All shares taken up. 10s. per share called up on 1,993, and £1 per share on 7. £1,003 10s. paid. Mortgages and charges: Nil.

Falvey's Turbine Syndicate, Ltd.—Two debentures dated November 14th, 1912, to secure £25, each charged on company's property, present and future, including uncalled capital. Holders: C. A. F. Green, 53, Peak Hill, Sydenham, and H. F. Crick, Pennington Vicarage, Lymington.

Singapore Electric Tramways, Ltd. (84,088).—A memorandum of satisfaction to the further extent of £3,900 of debentures, dated November 30th, 1906, securing £350,000, has been filed.

Samuel Harford & Co., Ltd.—Second mortgage debenture dated November 29th, 1912, to secure £1 000, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: N. Woollright, Holly Bank, 15, Hargreaves Road, Liverpool.

Newton & Pycroft, Ltd.—Mortgage on Alfred Street Mills, Ashforth Street, Nottingham, dated November 16th, 1912, to secure all moneys due or to become due from the company to London City and Midland Bank, Ltd., 5, Threadneedle Street, E.C.

J. Kirby & Co. (Leeds), Ltd.—Debenture dated November 5th, 1912, to secure £400, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: W. Scott, "Dunelin," Roundhay, Leeds.

CITY NOTES.

River Plate Electricity Co., Ltd.

An extraordinary general meeting of the shareholders of the above company was held on Wednesday, at the offices, 62, New Broad Street, E.C., Mr. M. W. Mattison presiding.

The Chairman proposed the following resolution:—"That the arrangement entered into between the River Plate Electricity Co., Ltd., and the Argentine Co. called 'La Electrica del Norte,' for the joint working of the stations and businesses of the separate companies in the city of Tucuman, and in the city of Santiago del Estero, Argentine Republic, be, and the same is hereby, approved and confirmed." He said that the arrangement was a very important one as far as their Tucuman undertaking was concerned. Its immediate effect provided for a working agreement with the La Electrica del Norte Co., including a complete pooling of the earnings of the two undertakings, and ultimately it contemplated a complete fusion between the two companies as far as Tucuman was concerned. It had nothing whatever to do with their La Plata or Ensenada undertakings, which formed the principal part of the business of the company. As they were aware, for many years they had supplied electric light and power to private consumers in Tucuman, and until recently their only competitor was the del Norte Co.—an Argentine company. That company, besides supplying private consumers, held the public lighting contract, and owned the only tramway system in the city. In addition, it owned an electric light station at Santiago, and altogether the interests of that company in the city were considerably larger than theirs. The geographical position of the city precluded the possibility of its ever being a great industrial centre, and it was obviously not a place which could support two competing power stations. Therefore, as the directors of both company's were business men, it was clear that sooner or later they would come together and combine their interests. It was possible that the arrangement now under consideration had been somewhat accelerated in the matter of time by the advent of a company called the Hydro-Electric Co. of Tucuman. That was an Argentine company which held a concession to develop water power at a point on the River Lules, some 15 or 16 miles from Tucuman. The board had known a good deal about the scheme from its inception. The original idea was to develop power on the river and convey it on overhead wires to Tucuman and sell it in bulk to companies like themselves. That was a proposition to which they neither could, nor did, take objection. They, however, never thought the project was commercially sound, and therefore they declined to risk their money in it, but they always expressed their readiness to purchase in bulk at a fair price. But the company had refused to deal with them on those lines—they were not content to be wholesale sellers of power, which was the *rôle* adopted by nineteen-twentieths of all successful hydro-electric companies in existence in the United States and elsewhere; they resolved to be retail sellers as well—in other words, instead of being content with one profit, they desired to get two, with the result, he ventured to say, that they would get neither. The competition at Tucuman had started; the installation of the Hydro-Electric Co. was completed to the extent that they were able to deliver light and power in the city, and from about the middle of November they had been supplying. They had issued a tariff which, as they (the directors) expected, was a highly competitive one. They were advised that even if the Hydro Co. could get the whole of the private lighting, which was done now by both companies—a most absurd and ridiculous supposition—the rates they were charging would not produce a net revenue which would equal depreciation and interest on debentures. As far as that company and the del Norte were concerned, they had met the rates by corresponding reductions, and if the Hydro Co. cut the rates still further, they would follow. The board deplored that ridiculous waste of money, but they were on the defensive, and they could do nothing else. He supposed the idea of the Hydro Co. was that, if the competition was made severe enough, the existing companies would be tired out, and though, in the meantime, the competitor might make losses, he would get them back when the other competitors were frozen out. The pooling arrangement between themselves and La Electrica del Norte they considered a most important step, for a combination of the interests of the two companies meant that if the Hydro-Electric Co. elected to continue the fight, they would have to fight a united, instead of a divided interest. There was the further consideration that the union of the two stations and the two staffs would mean a substantial reduction in working expenses. Another point which had to be weighed with them was that this arrangement would enable them to keep the finances of the fight in Tucuman largely apart from their undertakings in Ensenada and La Plata. As to how long the fight was likely to go on, he could only say it would last so long as was necessary to secure to La Electrica del Norte and themselves that full share of the business of lighting and power and traction to which they were entitled. It might take time, but however long the time they were prepared to wait, as they had no fixed charges to look to in Tucuman or for interest, and they had ample resources in other directions. Sooner or later, those who controlled the Hydro Co., if they ever desired a return upon the capital, would have to face the facts and revise their whole programme in accordance therewith. In the meantime they would do what every self-respecting company would do in like circumstances—maintain at all costs the bulk of their business in the city. He might take that opportunity of telling them that in La Plata and Ensenada, things had continued to develop favourably on the lines he had indicated at the last meeting, and unless something untoward happened in the next few weeks they would be able to present them with a satisfactory report next April. There was, of course, no probability of the board recommending any increase at present on the dividend of 10 per cent which had been paid for some time, but he thought they might confidently anticipate that the profits would admit of the payment of such a dividend with a handsome surplus. If the present situation continued in Tucuman until the spring, he thought it not unlikely that the board would decide to put the surplus to a special account applicable to the maintenance of their position there. For some time they had had the position in Tucuman in their mind, and had been making provision against it, and that, with the surplus they would have this year would, he believed, provide them with the sinews of war to carry on the fight for a longer period than, in his opinion, it was likely to last.

Mr. Robert Miller seconded the resolution, which, after a short discussion, was carried.

London Electrical Trading Co., Ltd.—Dr. Charlton Bastian, F.R.S. (chairman), presided on Tuesday last at the offices, 21, Broad Street House, E.C., over the second ordinary general meeting of the above company. We have received the following report of the proceedings: In moving the adoption of the report and balance-sheet, the chairman said that although only a small profit had been earned during the initial period of 18 months covered by the accounts, nevertheless, the prospects for the current period were very satisfactory, and only that day the company had booked an order for 1,150 heaters of a gross value of over £3,000. Bastian heaters were now being supplied to many foreign markets from London, Paris and Berlin, and a satisfactory increase in the demand was shown by the fact that the sales since the date of the balance-sheet showed an increase of nearly 40 per cent., as compared with the sales during the corresponding period the previous year. Business had already been opened up, not only in the home market but also in Germany, France, Spain, Scandinavia, Russia and several other Continental countries, but there were many markets in which the company had yet to create a demand for their products, and as further working capital could be profitably employed in this direction it had been decided to offer the unissued balance for subscription amongst the shareholders. Mr. A. R. Newman seconded the motion, and it was carried unanimously.

Isle of Thanet Electric Tramways and Lighting Co., Ltd.—The directors' report for the year ended Sept. 30th shows a profit of £19,769, compared with £21,785 in the previous year. The exceptionally wet and stormy weather during the season caused the traffic receipts to show a decrease of £2,683. The sale of electricity increased by £1,685, or nearly 24 per cent. The amount of undivided revenue at the disposal of the company, including £2,282 brought forward, is £13,831, and the directors recommend a dividend of 2½ per cent. on the preference shares, leaving £10,081, out of which it is proposed to place £1,500 to reserve account, to appropriate £5,000 towards future maintenance of permanent way, to add to third-party insurance reserve £1,000, and to carry forward £2,581.

United Electric Trams of Monte Video, Ltd.—The directors have declared an interim dividend at the rate of 6 per cent. per annum on the ordinary shares, for the half-year ended September 30th.

Capital Reduction.—A petition for confirmation of reduction of capital of the Metropolitan Electric Tramways, Ltd., from £1,500,000 to £1,078,504, is to be heard in the Courts on December 10th.

Lima Light, Power and Tramways Co.—The directors of the Empresas Electricas Asociadas have declared a dividend of 1¼ per cent. on the shares for the quarter ended September 30th.—*Financier.*

Electrical and General Investment Co., Ltd.—Interim dividend on ordinary shares of 1s. per share, being the maximum rate of 10 per cent. per annum for the six months ended November 30th.

Metropolitan Electric Tramways, Ltd.—On Wednesday, in London, a special meeting of the Metropolitan Electric Tramways, Ltd., was held with reference to the consolidation scheme.

Allgemeine Electricitats Gesellschaft. — According to the *Financial News*, this company held its meeting at Berlin on 2nd inst., at which the proposed increase of capital 25,000,000 m. to 155,000,000 m. was sanctioned.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.—It is announced in some of the daily papers that the directors have declared the usual half-yearly dividend on the preference shares, and one of 7½ per cent. on the ordinary shares.

Power Gas Corporation, Ltd.—A dividend of 4 per cent. on the ordinary shares is announced.

Siemens and Schuckert Companies.

THE *Rheinische Schuckert Ges. für Elektrische Industrie, of Mannheim*, realised gross profits of £84,000 from new undertakings, investments, &c., in 1911-12, as compared with £55,000 in the previous year, and the net profits were £49,000 and £28,000 in the two years respectively. The provision made for depreciation and reserve funds is £31,000, as against £13,600 in 1910-11, and the dividend is at the rate of 7½ per cent. on £275,000, as contrasted with a similar rate on £200,000 in the previous year. The loan capital amounts to £175,000, and a fresh increase in share capital is in contemplation in the near future.

The financial statement of the *Siemens-Schuckert Werke* indicates net profits of £673,000 for the year ended with July 31st, 1912, as compared with £671,000 in the previous year. It is proposed to pay to the two proprietary companies—Siemens & Halske and the Schuckert Co., of Nuremberg—a dividend of 10 per cent., this rate being the same as in 1910-11. The sum of £125,000 has been allocated to the reserve fund, as in the preceding year, and £17,500 to the disposition fund as in 1910-11. Bonuses to officials and workmen absorb £65,000, as compared with the same amount in the previous year, and the balance carried forward is £15,000, as against £14,000 in 1910-11.

The *Elektrizitäts A.G. vorm. Schuckert & Co., of Nuremberg*, whose heavy electrical engineering works were transferred to the Siemens-Schuckert works several years ago, reports gross profits of £428,000 for 1911-12, as compared with £362,000 in the previous year, the balance forward increasing the amount to £490,000, as against £423,000 in 1910-11. Administrative expenses, interest charges, taxes, and the customary provision for depreciation, absorb £130,000, as contrasted with £123,000, and the sum of £7,500 has been placed to the coupon tax reserve fund, leaving net profits of £352,000, as against £293,000 in 1910-11. The sum of £15,000, as in the preceding year, has been transferred to the special reserve fund, and after deducting "shares" in the profits there remains a balance of £322,000, as compared with £268,000. It is proposed to pay a dividend of 8 per cent. on the old shares of £3,000,000, and 4 per cent. on the new shares of £500,000, the former comparing with 7½ per cent. in 1910-11. The balance of £62,000 has been carried forward, as contrasted with a similar sum in 1910-11.

The accounts of *Siemens & Halske A.G., of Berlin*, shows net profits of £620,000 for 1911-12, as contrasted with £616,000 in the preceding year. It is intended to distribute 12 per cent. on the ordinary capital, being the same rate as in 1910-11. The sum of £100,000 has been transferred to the special reserve fund, as against £110,000 in 1910-11, and £17,500 to the disposition fund as in the previous year. The bonuses to workmen and officials amount to £45,000, as compared with £40,000, and the amount carried forward is £63,000, as contrasted with £54,000 in 1910-11. The financial development in the course of years has been as follows:—

	Net profits.	Percentage dividend.	Share capital.
1903-4	£276,000	7	£2,725,000
1904-5	349,000	9	2,725,000
1905-6	398,000	10	2,725,000
1906-7	435,000	11	2,725,000
1907-8	484,000	11	2,725,000
1908-9	571,000	12	3,150,000
1909-10	575,000	12	3,150,000
1910-11	616,000	12	3,150,000
1911-12	620,000	12	3,150,000

It will be observed that the net profits realised both in the case of the Siemens & Halske Co. and the Siemens-Schuckert Works in 1911-12 were not substantially different from those which were obtained in the preceding 12 months, whereas the Schuckert Co. secured an advance of £66,000, and the A.E.G. one of £102,000, as compared with 1910-11.

London United Tramways Co., Ltd.

MR. W. M. ACWORTH presided on Wednesday at Winchester House, E.C., over a special meeting of the shareholders of the above company.

The CHAIRMAN said there was no resolution to submit, as the meeting had only been called in order to explain the scheme which had been put forward by the Metropolitan Electric Tramways, Ltd., and the Tramways (M.E.T.) Omnibus Co. for consolidating their various interests. In the circular which had been issued they were invited to exchange their present holdings for holdings in the new London and Suburban Traction Co., Ltd., on certain terms. The directors advised the shareholders without any hesitation to accept those terms, and already a very large number of shareholders had acted upon that advice. According to the last figures available, 81,000 odd out of 125,000 preference shares had been lodged in favour of the scheme, and 91,000 odd out of 100,000 ordinary shares. With regard to the position of the London United Co., a dividend of 3 per cent. was paid on the ordinary shares for the year 1906; for 1907 1 per cent., and since then the ordinary shares had received nothing. The preference shares in 1908 were paid 3¾ per cent. for the year, but in subsequent years no dividend had been paid. The accumulated back dividends amounted to £203,000 at the end of the company's financial year, and there was another half-year's interim dividend which had also not been paid. As to future prospects, the net profits were not likely to be as good in 1912 as they were in 1911; in fact, the published figures showed that the gross receipts were £13,000 down. He had been looking through the speeches of his predecessors in that chair, and he found that in March, 1907, the ominous word "motor-'bus" first appeared; and the result of its appearance was shown in the dividend records since. None of them doubted that the motor-'bus had come to stay, and he did not think that they could reasonably expect, as time went on, that the efficiency of the motor-'bus would get less or its economy get worse. There was an old adage of administering to the patient a hair of the dog that bit him, and that in plain English was what they were suggesting by the present scheme. They were invited to exchange their shares into shares of the new company, which itself would own 350 motor-'buses, and they would be worked under conditions which would result in a substantial profit. The M.E.T. Co. decided some time ago to purchase and work a fleet of motor-'buses, and they formed a subsidiary company for that purpose, and being desirous to work in harmony with the L.G.O. Co., they entered into negotiations with that company, whose shares, as they knew, were owned now by the Underground Co. That company was also a very large holder in the London United Tramways, and so not unnaturally the sphere of the negotiations was widened, and the proposal now was to fuse the interests of the shareholders of the London United, with those of the Metropolitan Electric Tramways and the Tramways (M.E.T.) Co. It was proposed to work the two systems of tramways as one undertaking, and to secure that the 350 motor-'buses should be worked by the L.G.O. Co. for the joint profit of the two companies. The unification of the management of this large tramway undertaking with over 100 miles of track, and carrying over 150 million passengers per annum, would, he had no doubt, secure considerable economies. The shares in the Metropolitan Electric Tramways carried with them a valuable asset in the company's holding of the ordinary shares of the North Metropolitan Electric Power Supply Co., which had four generating stations in important centres in the north of London, and which was doing a growing and a profitable business. Under the scheme the 350 'buses would be the property of the Metropolitan Electric Traction Omnibus Co., and the whole of the shares of that company would be made over to the new company, and the new company would receive the whole of the profit therefrom. The plan by which those 'buses would be treated for all purposes, except in respect of profits, as part of the L.G.O. Co.'s fleet would, he thought, commend itself to them all. The stipulation was that the net profit on each of their 'buses should be the average of the earnings of the 'buses worked by the L.G.O. Co. in the London area, which, he thought, secured them a fair share of all the profit that was to be had. With regard to the financial aspect of the scheme, the debentures would remain untouched. The preference shareholders, for each £10 share with all its rights, were offered £5 in cumulative preference shares and £4 12s. in ordinary shares of the new company. They had told them in the circular that they anticipated that the new company would enjoy a revenue sufficient to secure a fair return on its ordinary share capital. They had been asked what they meant by a "fair" return. Personally, he had no hesitation in saying that he looked for a substantial return, but the factors in the problem were so numerous, and conditions changed so rapidly, that nobody in a responsible position in the company could attempt to translate the word "fair" into any precise figure. He might say that the Underground Co. had shown their confidence in the new company by consenting to a large reduction in their nominal capital. If any preference shareholders preferred to remain out of the scheme, they would retain all their present rights; and it was for them to consider what those rights were worth in the altered condition of affairs.

MR. A. J. WOOD criticised the action of the directors in regard to the way in which the preference shareholders were to be treated, as compared with the debenture-holders.

MAJOR SKINNER said he thought the directors had done the very best they could under the circumstances. The fact was they had gone on in the belief that the tramcar was to be the locomotion of the future, but it was not, and that was an end of the matter.

The CHAIRMAN, in reply, remarked that when the London United Tramways was formed, the present position was not on the horizon, and no blame rested either on the shareholders or directors. It was impossible to deal with the debenture-holders in any other way than was proposed under the scheme, because their interests were protected by a deed.

The meeting then terminated.

Shropshire, Staffordshire and Worcestershire Electric Power Co.—The directors report that the accounts for the half-year to June 30th, including £84 brought forward, show an available balance of £4,118, which the directors recommend should be carried forward.—*Financier.*

West Kootenay Power and Light Co., Ltd.—The directors have declared a dividend on the Common stock, at the rate of 4 per cent. per annum, payable 1 per cent. quarterly, commencing December 1st next.

Continental.—FRANCE.—The report of the Compagnie d'Electricité de Marseille, of Marseilles, for the last financial year shows a net profit of £27,996, as compared with £24,300 in the preceding 12 months. No dividend is being declared, the bulk of the profits being applied to depreciation and reserve.

Meldrum Bros., Ltd.—According to the *Times*, the liquidator announces that the works and assets of the company at Timperley, together with the goodwill and book debts, have been transferred to a new company, which will continue the business under the style of Meldrums, Ltd. Mr. J. W. Meldrum, manager during the liquidation, will be the managing director.

Tramways (M.E.T.) Omnibus Co., Ltd.

THE holding of an ordinary general meeting of this company at the Electrical Federation Offices, Kingsway, W.C., on November 28th, is reported in the Press. MR. JAMES DEVONSHIRE (the chairman) said that their financial year ended on September 30th, and they were unable before that date to place any of their omnibuses in public service, so that there was no profit and loss account. They had increased their order for chassis from 300 to 350 in number. All these chassis were being supplied by the Daimler Co., and the bodies were being manufactured by the Brush Electrical Engineering Co. and by Messrs. Dodson. Some of the omnibuses supplied to companies other than their own were already on the streets of London. Deliveries of their completed omnibuses had already begun, and in the course of the next few weeks the first batch should be placed in public service. The formation of this company resulted in negotiations between the Metropolitan Electric Tramways Co. and the London General Omnibus Co. These negotiations had now culminated in several agreements, to one of which this company and the L.G.O. were parties. The agreement provided that their fleet of omnibuses, which was to be limited to 350, was to be worked and maintained for them by the L.G.O. Co., as part of that company's fleet. Generally, the effect of the agreement was that, instead of their omnibuses suffering from severe competition from the omnibus fleet of the L.G.O., they would be worked by that company as part of their fleet, so as to avoid unnecessary duplication of existing services. The earnings of this company's omnibuses would be paid over to them, less the expenses of working, and it was agreed that their gross earnings were not to be less than the average gross earnings of the combined fleets of this company and the London General Omnibus working in the metropolitan area. They were thus assured of a fair average return from each omnibus working.

The report was adopted.

Cordoba Light, Power and Traction Co., Ltd.

THE directors' report to September 30th, 1912, states that the balance of profit to that date, after meeting all charges, is £33,410, plus £9,220 brought forward, making £42,631. Out of this the directors recommend that a dividend at the rate of 5 per cent. (less income-tax) be paid, and that the balance of £12,631 be carried forward. Since the date of the last report the company has acquired further shares of the Cordoba Light and Power Co., and now owns 99·49 per cent. of that company's share capital, together with the whole share capital of the Cordoba (Argentine) Electric Tramways Construction Co., Ltd. Delivery of the remaining small balance of shares of the Power Co. has been promised. The new hydraulic station of the power company has been working most satisfactorily since its opening for public service at the end of February, so that for some months past the company has been relieved of the heavy expenses of operating the steam plant. The whole of the system covered by the concession of the tramways company has been converted to electric traction, the company now having 25¼ miles of track in operation, and, in addition, nearly 4 miles constructed, but not in operation. The results of the operation of the two subsidiary companies for the last few months, during which the above-mentioned improved conditions have prevailed, fully come up to the directors' anticipations. The power company has outstanding £100,000 5 per cent. bonds forming a first charge upon its property, and, therefore, ranking in priority to the debenture stock of this company. These bonds fall due on January 1st, 1913, and it is intended to remove the priority referred to by repaying them out of the funds to be provided by this company. To provide for the growth in the immediate future of the business of the subsidiary companies, extensions of the distribution system of the power company and of the lines of the tramways company are in progress as well as sundry minor works. For these purposes it is proposed to issue £300,000 of the balance of the company's unissued share capital in the form of 6 per cent. preference shares, entitled to a premium of 20 per cent. in event of liquidation or return of capital. The necessary resolution will be submitted to the general meeting. The directors refer with regret to the death of Sir J. Irving Courtenay, who acted as chairman of the company since its inception. Mr. T. Frame Thomson has been elected to the position of chairman.

MR. T. FRAME THOMSON presided on Wednesday at the offices, 62, London Wall, E.C., over the fourth annual general meeting of the company. In moving the adoption of the above report, he said that they were meeting under circumstances of peculiar sadness, as Sir Irving Courtenay, who had been chairman of the company since its inception, died only a few weeks ago. It was particularly sad that just as they were getting to the point they had been aiming at for four years, he should be taken away. The letter which he had addressed to the shareholders would have given them full information as to the history of the company and its present position, and consequently it was not necessary for him to say much on that occasion. The company was formed for the purpose of giving considerable development to the business of the Cordoba Light and Power Co., and of protecting the position of that company by adding a tramways system to the electric light and power system. These objects had now been accomplished, and in the last few months they had been entering on the stage of reaping the benefit of the exchanges which had been made, and they might quite reasonably expect that the benefit would be very considerable. The few months during which they had been working had shown a very remarkable increase in the business, and he thought there was every reason to expect that in a very short time they would make up the leeway lost during the period of construction, and at the time when they were suffering from shortage of water.

MR. H. A. TROTTER seconded the motion, which was adopted without discussion.

In moving the re-election of Messrs. H. A. Trotter and A. D'Abbadie D'Arrast as directors, the CHAIRMAN said the latter gentleman was, until last year, the manager in Cordoba, and was thoroughly familiar with the situation there. He had now decided to reside in Europe, and the board were very glad to have the assistance of his practical knowledge.

MR. C. M. ROSE seconded the motion, and it was carried.

An extraordinary general meeting followed, when, on the motion of the CHAIRMAN, seconded by MR. G. KITCHIN, the following resolution was agreed to :—

Of the 400,000 unissued shares of the company 300,000 shall be called preference shares and such preference shares shall confer the right to a fixed cumulative preferential dividend at the rate of 6 per cent. per annum on the capital for the time being paid up thereon and the right, in the event of a winding up or return of capital, to a bonus of 20 per cent. on their nominal value, and shall rank as regards return of capital, and the said bonus in priority to the ordinary shares, but shall not confer the right to any further participation in profits or assets. The remaining 100,000 shares of the existing capital of the company may be issued either as preference shares ranking *pari passu* for all purposes with the said 300,000 preference shares or as ordinary shares, as may from time to time be determined by the directors.

Adelaide Electric Supply Co., Ltd.—In their report for the year ended August 31st, 1912, the directors state that they have continued their policy of energetic development during the year, and have expended a further £102,645 on capital account in the provision of additional land, buildings, plant and mains. For the purpose of providing the necessary additional capital to carry out such development and to keep pace with the continued growth of the company's undertaking, a further £50,000 5 per cent. debenture stock has been issued during the year at a premium. For the same purpose a further 10,000 ordinary shares were offered to the ordinary shareholders in July last at a premium of £3 per share, ranking for dividend as from September 1st, 1912; the whole of these shares have been allotted and paid for in full. The profit and loss account shows a credit balance of £27,622. After paying the dividend on the preference shares for the half-year, and an interim dividend of 5 per cent. on the ordinary shares, there remains an available balance of £20,007, out of which the directors recommend a final dividend of 5 per cent. on the 30,000 ordinary shares, making 10 per cent. for the year, and a bonus of 2 per cent., free of tax, the balance carried forward being £5,007. The premiums received on the issues of debenture stock and ordinary shares, amounting to £31,049, are being added to general reserve, and certain special items in the capital account, amounting to £3,720, have been written off out of such reserve. The *Times* states that: "In view of the termination of the company's contract for the temporary supply of power to the Adelaide Municipal Tramways Trust, and the consequent shrinkage of revenue resulting therefrom, the board had set aside out of the profits of previous years a dividend equalisation fund amounting to £25,000."

Official Announcements *re* Companies.—The following companies will, unless cause is shown to the contrary, be struck off the Register within three months, and will accordingly be dissolved :—

Acme Conveyor and Machine Co., Ltd.
Dynamo Electric Car Transmission Syndicate, Ltd.
Electrical Fittings Co., Ltd.
Electrocab Development Co., Ltd.
Foxcroft and Duncan Engineering Co., Ltd.
London Electrocab Co., Ltd.
Nitrogen Power Syndicate, Ltd.
Norfolk Electrical Co., Ltd.
Orient Electric Power Syndicate, Ltd.

Imperial Tramways Co., Ltd.—The directors have issued to the preference and ordinary shareholders a statement regarding the proposal of the London United Tramways Co. (in which the Imperial Co. has a large preference holding) to consolidate its interests with those of the Metropolitan Electric Tramways Co. The scheme proposes to give in exchange for each existing £10 5 per cent. preference share of the London United Co., the following :—£5 in 5 per cent. cumulative preference shares, and £4 12s. in ordinary shares of the new company—the London and Suburban Traction Co., Ltd. The directors say that they have resolved to approve the scheme, inasmuch as, when it is carried through, the payment of dividends on both the preference and ordinary share capital of the Imperial Co. will be resumed at an early date.

Douglas Southern Electric Tramways, Ltd.—At the annual meeting, held in Manchester on the 3rd inst., Mr. T. J. Hutchinson presiding, it was stated that the total traffic receipts showed a decrease of £441, which was attributed to the cold and wet weather experienced throughout the season. A dividend of 6 per cent. upon the preference shares, absorbing £1,558, was agreed to, and the balance of £326 was carried forward.

The Paris Popp Co.—The accounts of the Compagnie Parisienne de l'Air Comprimé (Popp) for the year ended with June 30th, 1912, shows gross profits of £208,000, as contrasted with £194,000 in the preceding 12 months. After providing for depreciation, the net profits are returned at £137,000, as against £101,000 in 1910-11. The dividend amounts to £1 16s. per £20 share, as compared with £1 12s. per share in the previous year.

Ruston, Proctor & Co., Ltd.—An interim dividend of 5 per cent. per annum on the ordinary shares is announced.

British Columbia Electric Railway Co., Ltd.

THE fifteenth annual report shows that the business has continued to grow very rapidly. For the 12 months to June 30th, 1912, the gross receipts show an increase of $1,601,994, or over 36 per cent., and the net earnings, including income from investments and subsidiary companies, and after charging renewals, show an increase of $401,837, or 27 per cent., over the preceding year. From June 30th, the close of the period under review, up to September 30th last, there has been a still further increase in gross earnings of $352,233, or 27 per cent., and in net earnings $138,204, or 31 per cent. The increase in business is well distributed over every department and over all branches of the railway system, but it is especially noticeable in the city of Victoria. During the whole of the 12 months under review, very large sums of money have been involved in various works and extensions under construction, and have consequently remained unremunerative. The following charges have been made against the revenue account of the year, viz., provision for renewals maintenance (from which £22,110 has been deducted for adjustments and expenditure on renewals during the year) £95,232; amount added to capital amortization fund, £2 270 = £97,502. The net profit for the year, after making these deductions, amounts to £359,131, plus £6,590 brought forward, making £365,721, from which there are deducted the following: Interest on debentures and debenture stock to June 30th, 1912, £101,460; dividends already paid—on 5 per cent. cumulative perpetual preference stock for the year ended June 30th, 1912, £50,000; on preferred ordinary stock for the year ended June 30th, 1912, £60,000; and on deferred ordinary stock for the six months to December 31st, 1911, £40,000, leaving available for further distribution and reserve, £114,260. From this the directors recommend a dividend on the deferred ordinary stock at the rate of 8 per cent. per annum for the six months to June 30th, 1912, making 8 per cent. for the year, £40,000, transferring to reserve fund £66,528, and carrying forward £7,732. There has been added to the reserve fund £55,471, representing the premium, less expenses, on £600,000 new capital, issued in July, 1911. After the transfer now recommended by the directors as above, the reserve fund will amount to £459,000. The growth of the company's business is indicated by the following figures:—

MILES OF TRACK IN OPERATION.		TOTAL CARS OF ALL CLASSES.	
1909	97·74	1909	248
1910	141·65	1910	427
1911	233·65	1911	647
1912	285·75	1912	725

Passengers carried during the year were 62,154,166, an increase of 15,612,718. Number of lamps in use, 735,426, an increase of 171,884.

In accordance with the established custom of the board for some of the directors to visit British Columbia annually, Mr. Blundell Brown went there in May last, and during his stay thoroughly discussed and investigated existing conditions and future prospects with the management and with many leading British Columbians. He reports much prosperity throughout the country, and is well satisfied with the great expansion of the company's enterprise since his last visit four years ago. He is entirely convinced that the progressive policy adopted by the company is wise and justifiable. Very important works have been carried out during the year, and are still under construction.

The extension of the hydroelectric power plant at Lake Coquitlam and Lake Buntzen has been successsfully carried on, and will be completed during next summer. Already the work has provided the company with largely increased water storage. The magnitude of the undertaking may be gathered from the following particulars: A new dam is being built at Lake Coquitlam—maximum height, 98 ft.; width at base, 600 ft.; length at crest, 850 ft.; width at crest, 40 ft.; storage capacity, 7,404,000,000 cb. ft., giving an available reserve during a dry season of 53,700,000 KW.-hours of electrical energy: 1,055,000 cb. yards of material will have been handled on completion of the works. The number of men employed on the work during the last six months has varied from 1,289 to 1,514.

An additional and separate power house of a massive character, with foundations on the solid rock, is being built at Lake Buntzen. Three hydroelectric units will be installed therein, having a combined capacity of 40,500 H.P. These, added to the units already in operation in the old power house, will give a total available supply of 82,500 electrical H.P. The directors had hoped that these new units would have been ready for operation in November, but, owing to labour troubles experienced in Great Britain, considerable delay occurred in the manufacture of the generators, and it was found impossible to ship the first generator from Birkenhead before October 12th. It is expected that the first unit will be in service during the month of February. The completion of the works above referred to will place the company, so far as power is concerned, in a very satisfactory position, and after February next, in return for the heavy capital expenditure of the past three years, it will have a very large power development at an economical figure, and one in which maintenance and operating expenses will be reduced to a minimum. In every detail the most modern practice in hydro-electric power plant design has been adopted, the best features of European and American design having been combined to produce a plant which will, undoubtedly, be one of the finest in the world. On Vancouver Island the company is also largely increasing its hydro-electric power installation to meet the rapidly increasing business in the city of Victoria and surrounding districts. The first Jordan River installation was put into operation in February, and consisted of one 6,000-H.P. impulse wheel on the shaft of a 4,000-KW. alternator, with all the necessary complementary equipment. A second unit of equal capacity has been completed within the last few weeks, and is now delivering power in Victoria. The dam connected with this installation was completed by May, 1912, and has a capacity of 327,900,000 cb. ft., which is equivalent to the storage of 5,960,000 KW.-hours of electrical energy. The company is also constructing, near Victoria, with a separate transmission line, an auxiliary steam plant having an initial capacity of two 2,000-KW. units. The design has been laid out so that, in the future, new units can be added very economically and quickly.

The railway from Victoria through the Saanich Peninsula, about 20 miles in length, referred to in the last directors' report, is now nearing completion, and the board hope that the line will be in operation during the month of December; some 8 miles radiating from New Westminster have either been completed during the year or are approaching completion. The company is also building several extensions in North Vancouver, South Vancouver, Point Grey and Victoria, aggregating over 15 miles.

Large purchases of rolling stock have been made, in addition to which the company's own car shops at New Westminster have been kept working to their fullest capacity, and have turned out a large number of excellent cars.

The terminal station and central offices of the company in Vancouver have been completed, and constitute one of the most conspicuous and important structures in the city. The offices are now occupied by the staff, and the excellent accommodation which they provide should greatly facilitate the administration of the company's business.

During the year the company was compelled to suspend traffic in the municipality of Point Grey, owing to legal proceedings having been instituted which challenged the validity of its franchises. This question has been satisfactorily terminated by a vote of the people of Point Grey, who, by a very large majority, passed a by-law confirming our franchises for the unexpired 37 years.

Resolutions will be submitted to the stockholders at the annual meeting altering the articles of association. Under the articles of association it is provided that no more of the company's cumulative preference stock shall be issued than the amount already paid up on the preferred ordinary stock, and that no more of the preferred ordinary stock may be issued than the amount already paid up on the deferred ordinary stock. The new resolutions will have the effect of making certain that the directors have power to issue equal amounts of the three stocks simultaneously, notwithstanding that all the calls on the junior stocks may not have been actually paid up at the time that the senior stocks may be issued.

H.R.H. the Duke of Connaught visited Vancouver and Victoria in September. A special train was placed at the disposal of His Royal Highness, who expressed his appreciation of the importance and value of the undertaking in the kindest terms. The directors again have pleasure in expressing their appreciation of the loyal and satisfactory services rendered by the management and staff in British Columbia.

Year ended June 30th.	Gross earnings.	Net rev. inc. investments income.	Passengers.	Lamps in use.	Balance available for dividend.	Pref. ord. stock, div. per annum.	Def. ord. stock, div. per annum.	Amount to reserves.
1910 ..	£828,763	£226,804	34,476,804	439,315	£149,391	6 %	8 %	£108,265
1911 ..	901,463	262,993	46,541,448	563,542	158,455	6 %	8 %	158,571
1912 ..	1,231,861	385,846	62,154,166	735,426	257,670	6 %	8 %	197,391

The annual meeting is called for Tuesday, December 10th, at Liverpool Street Hotel, E.C.

Stock Exchange Notices.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

General Electric Co., U.S.A.—Scrip, fully and partly paid, for $4,000,000 5 per cent. gold debenture bonds (London issue).

Sao Paulo Electric Co., Ltd.—Scrip, fully and partly paid, for £1,880,000 5 per cent. 50-year first mortgage bonds.

And to allow the following securities to be quoted in the Official List:—

British Columbia Electric Railway Co., Ltd.—Further issue of £200,000 deferred ordinary stock; £200,000 preferred ordinary stock; and £200,000 5 per cent. cumulative perpetual preference stock.

Montreal Tramways Co.—$10,445,000 first and refunding mortgage 5 per cent. 30-year gold bonds.

The Committee has appointed a settling day as under:—

Thursday, December 19th.—Sherbrooke Railway and Power Co.—$300,000 5 per cent. 30-year consolidated first mortgage sinking fund gold bonds of $500 each (Nos. 1,801 to 1,900).

And ordered the undermentioned to be quoted in the Official List:—

Melbourne Electric Supply Co., Ltd.—Further issue of £125,880 consolidated ordinary stock.

Pueblo Tramway, Light and Power Co.—65,000 shares of $100 each, and $4,349,900 first mortgage 30-year 5 per cent. gold bonds (Nos. A 1 to 600 of $1,000, B 1,001 to 6,000 and 25,001 to 25,399 of $500, and C 6,001 to 16,504 of $100 each).

Sao Paulo Tramway, Light and Power Co., Ltd.—Further issue of £221,917 5 per cent. perpetual consolidated debenture stock.

Amalgamation.—According to reports published in several of the financial papers early this week, a merger scheme of considerable importance, embracing the supply of electricity for power and lighting purposes and the operation of tramways, is on the point of completion and will shortly be carried into effect. "The sphere of operations will include four of the most important Midland counties of England, representing an area of over 2,500 square miles. The undertaking has been financed by the Balfour group."

Richard Hornsby & Sons, Ltd.—The directors' report for the year ended September 30th shows a profit of £45,392, after writing off depreciation and paying directors' remuneration. After paying debenture interest and preference dividend, dividends at the rate of 6¼ per cent. are paid on the ordinary and the new shares, and £10,000 is placed in reserve, leaving to carry forward £3,877.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and may vary according to quantities and other circumstances.

Wednesday, December 4th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	per lb.	2¾d.	..
a „ Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	„	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£29 10	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16 10	..
a Copper Sulphate	„	£26	..
a Lead, Nitrate	„	£29	£1 dec.
a „ White Sugar	„	£25 10	..
a „ Peroxide	„	£32	..
c Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (88/90 %) ..	per ton	£22 10	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide (98/100 %) .. (for mining purposes only)	„	7½d.	..
a Shellac	per cwt.	72/6	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70/72 %) ..	„	£10 5	..
a „ Chlorate	per lb.	3½d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£90	..
b „ Wire, in ton lots ..	„	£112	..
b „ Sheet, in ton lots ..	„	£120	..
p Babbitt's metal ingots	„	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	9¼d.	..
c „ Tube (brazed)	„	11¼d.	..
c „ „ (solid drawn) ..	„	9¾d.	..
c „ Wire, basis	„	9¾d.	..
c Copper Tubes (brazed)	„	1/0¾d.	..
c „ „ (solid drawn) ..	„	11⅜d.	..
g „ Bars (best selected) ..	per ton	£93	..
g „ Sheet	„	£93	..
g „ Rod	„	£93	..
d „ (Electrolytic) Bars ..	„	£82	..
d „ „ Sheets ..	„	£99	..
d „ „ Rods	„	£87	..
d „ „ H.C. Wire	per lb.	10⅜d.	..
f Ebonite Rod	„	6/8	..
f „ Sheet	„	4/9	..
n German Silver Wire	„	1/10	..
h Gutta-percha, fine	„	..	..
h India-rubber, Para fine	„	4/6½	½d. inc.
i Iron Pig (Cleveland warrants) ..	per ton	67/1	11d. dec.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Pig	„	£18 7 6 to £18 12 6	5/- dec.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£7 12 6	..
e Mica (in original cases) small ..	per lb.	6d. to 3s.	..
e „ „ „ medium	„	3/6 to 6/-	..
e „ „ „ large ..	„	7/6 to 11/-	..
p Phosphor Bronze, plain castings	„	1/2 to 1/4	inc.
p „ „ rolled bars & rods	„	1/3	..
p „ „ rolled strip & sheet	„	1/3½	..
o Platinum	per oz.	135/-	..
d Silicium Bronze Wire	per lb.	11¼d.	..
Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£228 to £229	£1 dec.
n „ Wire, Nos. 1 to 16	per lb.	2/9	1d. inc.
p White Anti-friction Metals ..	per ton	£45 to £230	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	£31 12 6	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Denuis & C.

STOCKS AND SHARES.

Tuesday Evening.

Markets round the Stock Exchange cannot be accused of weakness, although they might have some difficulty in defending themselves from the charge of lacking business. It is customary for December to be a fairly strong month for prices, except perhaps just in the last few days, when an occasional bolt from the blue has been known to fall. Speaking electrically, the main theme of interest in the financial world continues to be the transport fusion—or fusions; although, so far as prices are concerned, they have not had much further effect.

The Home Railway market is strong as a whole, nor do the hints of labour trouble in connection with the Midland and North-Eastern Railways depress the general sentiment, which is buoyed by the expectation of the coming dividends and supplemented by the remarkable strength of Consols. Central Londons are, however, a dull spot, the Ordinary and Deferred stock both falling a point; while City and South London Ordinary lost ½, though this company's four Preference stocks all moved up 1. The shrinkages in the Tube Ordinary stocks will not occasion surprise to those who are accustomed to the Stock Exchage habit of discounting favourable events in advance. Evidently it was known to some people that the Central London and the City Companies were to be included in the Speyer group; the information must have been in their possession a week or two before its publication, and they sold as soon as the details were announced. Metropolitan Consolidated has fallen 1 upon the declaration that the Company will remain independent of the Underground group, but Districts spurted at one time to 42½, this leaving the substantial rise of 2¼ on the week. Underground Electric Railway issues are strong. There is persistent buying of the shares, and the Income Debentures gained 3 points, rising to 92, while the 1s. shares are steady at 13s. 9d.

London United Tramways shares fell back 10s., and Metropolitan Electric Trams Ordinary are ⅛ lower, while the Deferred and the Preference are also down. The fall in London United Preference is due to realisations by those who consider that the recent rise afforded them an excellent opportunity for getting out of their shares, in which course they were, perhaps, perfectly correct. The Company's 4 per cent. Debenture stock continues to creep up, and shows a further small gain on the week. In the traction group, Potteries hardened to 7s. 6d., and a few rises occurred in British Electric Traction issues, the 7 per cent. Preferred at 39½ being 2 up.

In the Foreign division, a report of considerable interest is that of the British Columbia Electric Railway Company, which tells of steady progress, necessitating further increase of capital. The Company's stocks are unchanged on the week. A private letter received from a young artisan in Vancouver tells of the way in which that country is going ahead by leaps and bounds, and throws an interesting sidelight on the necessity for additional rolling stock on the British Columbia Electric Railway system. The lad writes that from January 1st the Company will not be allowed to carry anyone who cannot find a seat on their cars; and he adds, as an illustration of the way in which the traffic increases, that he thinks nothing of having to ride home on the cowcatcher, accompanied by 10 or 12 others, and then, remarks our correspondent, "they have the sauce to come and collect the fare!"

The quotations for Rio Trams shares and Sao Paulo Trams shares have been taken out of the Stock Exchange Official List, there being hardly any market now for these, although the Company's bonds are, of course, readily marketable. The Common shares, however, have been largely exchanged for Brazilian Traction, Light and Power shares, and we have, accordingly, added the latter to our list of prices overleaf.

Supply and Power issues of Colonial and Foreign countries are mostly steady. Mexico Tramways are a strong market with a rise of 2. Shawinigan Water has given way, but Canadian Generals are very firm. Cordoba 5 per cent. Debentures are a shade harder, and there are not many other quotable changes in the list, except for a few *ex*-dividend markings.

English Electricity Supply shares are very firm as a whole, notwithstanding rumours to the effect that there has been a hitch in the reported negotiations which are said to have been going on between the Supply Companies and the local authorities with a view to closer working agreements. These reports, it may be observed, have been treated with reserve here since they first came into circulation. Big names have been mentioned in connection with the scheme, but those closely in touch with the industry know well how extremely difficult it is to harmonise the many conflicting interests that are found to exist when the subject is tackled at close grips.

Charing Cross Ordinary are ⅛ easier at £5 middle, but Counties rose ⅛ to 11½, at which, at the time of writing, there are buyers. The Company's new Ordinary shares were marked up 7s. 6d. to 11⅛ middle. Chelseas rose to 4⅞. City Lights are unaltered. The price of Edmundsons was put down $\frac{1}{16}$ to 10s. London Electric Ordinary are ⅛ easier. The market is in a state of suspended animation, although for a few shares there is still a fair demand. Nobody outside the inner ring knows what is going to happen, and the whole position is one of as much interest as uncertainty.

The Telegraph market continues strong, and the recent rises in the Eastern group are well held. Western Telegraphs have come into request this week, and Eastern Extensions are again ⅛ higher. Eastern Ordinary shows a rise of 1. On the other hand, Indo-Europeans and Cuba Telegraphs are 10s. lower. Telephones are quiet, with small rises in United River Plates and Orientals. There has been a spurt in National Telephone Deferred, and some sort of information with respect to what the company may expect to receive from the arbitrators will be out, it is thought, pretty soon. It is announced that an agreement has already been reached in respect of 10 million pounds out of the total claim of 20 millions. The Marconi market is quiet, and the shares show very little alteration, business in them having fallen away to retail proportions.

Willans & Robinson shares, both Ordinary and Preference, are still flatter, having fallen to 2s. 6d. and 10s. respectively—the quotations are somewhat nominal in each case. In the rubber market, the leading shares were hardened by Mr. Arthur Lampard's speech at the United Serdang meeting on Monday afternoon, in which he spoke optimistically of the prospects for consumption of the raw stuff. But it cannot be said that there is much increase in public demand for rubber shares.

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 3rd.	Rise + or Fall −	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5½	5†	9⅛ — 10⅛	..	5 4 9
Do. 4½ % Pref.	10	4½	4½	8⅝ — 9⅝	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10 — 10½	..	5 14 8
Do. 4½ % Deb. Stock	Stock	4½	4½	98 —100	..	4 10 0
Brompton & Kensington, Ord.	5	10	9†	9 — 9⅛	..	5 5 3
Do. 7 % Cum. Pref.	5	7	7	8⅞ — 9	..	3 17 9
Central Electric Supply, 4 % Guar. Deb.	100	4	4	95 — 98 xd	..	4 1 8
Charing Cross, West End & City	5	5	5†	4⅜ — 5⅛	— ⅛	4 15 3
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 4⅝	..	4 14 9
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	4 — 4½	..	5 0 0
Do. Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Chelsea, Ord.	5	5	4†	4⅜ — 5⅛	+ ⅛	4 17 7
Do. 4½ % Deb.	Stock	4½	4½	98 —101	..	4 9 1
City of London, Ord.	10	8	6†	16 — 18	..	4 9 0
Do. 6 % Cum. Pref.	10	6	6	12½ — 14	..	4 5 9
Do. 5 % Deb.	Stock	5	5	118 —122	..	4 2 0
Do. 4½ % Second Deb.	100	4½	4½	100 —108	..	4 7 5
County of London, Ord.	10	6	4†	11⅛ — 11⅞	+ ⅛	5 2 2
Do. 6 % Pref.	10	6	6	11⅝ — 12⅜	..	4 19 0
Do. 4½ % Deb.	Stock	4½	4½	106 —108	..	4 3 4
Do. 4½ % Second Deb.	Stock	4½	4½	98 —101	..	4 8 3
Edmundson's, Ord.	5	Nil	..	⅜ — ⅝	— ⅛	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	3 — 3⅝	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 8 6
Folkestone	5	6	6	4⅝ — 5⅛	..	5 17 1
Do. 5 % Cum. Pref.	5	5	5	4⅝ — 5⅛	..	4 17 7
Do. 4½ % First Deb.	100	4½	4½	92 — 95	..	4 14 9
Hove	5	9	8†	7⅞ — 8	..	5 12 6
Kensington & Knightsbridge, Ord	5	9	8†	7⅝ — 8⅛	..	5 10 9
Do. 4 % Deb.	Stock	4	4	90 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	78 — 82	..	5 9 9
London Electric, Ord.	8	2½	..	1½ — 2	— ½	3 15 0
Do. 6 % Pref.	5	6	6	4⅜ — 5½	..	5 14 3
Do. 4 % First Mort. Deb.	Stock	4	4	90 — 93	..	4 6 0
Metropolitan	5	4	4†	8⅜ — 8⅞	..	5 3 3
Do. 4½ % Cum. Pref.	5	4½	4½	4½ — 4⅝	..	4 17 4
Do. 4½ % First Mort. Deb.	Stock	4½	4½	99 —102	..	4 8 3
Do. 3½ % Mort. Deb.	Stock	3½	3½	86 — 88	..	3 19 7
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	99 — 101	+1	4 9 1
Newcastle-on-Tyne 5 % Pref., Non-Cum.	5	5	5	4⅜ — 4⅞	..	5 2 7
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	98½ —101½	..	4 18 6
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	10 — 11	..	5 9 1
Oxford	5	7½	6†	6⅛ — 6⅝	..	5 9 6
St. James' and Pall Mall, Ord.	5	10	10†	9½ — 10½	..	4 17 7
Do. 7 % Pref.	5	7	7	6¾ — 7¼	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	85 — 88	..	3 19 7
Smithfield Markets, Ord.	5	2	..	1⅜ — 1⅞	..	..
South London, Ord.	4	5	..	2⅜ — 3⅜	..	5 18 4
Do. 5 % First Mort. Deb.	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1⅝ — 1⅞	..	5 9 5
Do. 4½ % First Deb. Stock	100	4½	4½	96 — 99	..	4 11 0
Urban, Ord.	£2	Nil	..	⅛ — ¼	..	..
Do. 5 % Cum. Pref.	5	2	..	2⅛ — 3⅛	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	84½ — 88½	..	5 1 8
Westminster, Ord.	5	10	9†	8½ — 9½	..	5 8 1
Do. 4½ % Cum. Pref.	5	4½	4½	4⅞ — 5⅛	..	4 5 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 6 8
Calcutta, Ord.	5	8½	7†	6⅜ — 7⅛ x	..	5 19 4
Do. 5 % Pref.	5	5	5	4 13/16 — 5 1/16	..	4 16 5
Calgary Power, 1st Mort. Bds.	100	5	5	94 — 96	+ ½	5 4 2
Canadian Gen. El. Com.	$100	7	7	118 —122	..	5 14 8
Do. 7 % Pref.	$100	7	7	118 —122	..	5 14 9
Cordoba Lt., Power and T., Ord.	1	3	..	⅞ — 1	..	3 0 0
Do. 5 % Deb.	100	5	5	95 — 98	+1	5 2 0
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	95 — 97	..	6 3 9
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	85 — 88	..	5 13 8
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	95½ — 97½	..	5 2 7
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	1/16 — 5/16	..	Nil
Do. 6 % Pref.	1	6	6	15/16 — 1 1/16	..	8 14 6
Kaministiquia Power, 5 % G. Bs.	$500	5	5	104 —106	..	4 14 4
Madras, Ord.	5	Nil	..	1½ — 2	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	102 —105	..	4 15 3
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	86 — 88	..	5 13 8
Mexican Lt. & Power, Common	$100	4	4†	84 — 88	..	4 11 0
Do. 7 % Cum. Pref.	$100	7	7	103 —106	..	6 12 1
Do. 5 % 1st Mort. Gold Bds.	..	5	5	95 — 97	..	5 3 1
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	84 — 87	..	5 15 0
Montreal, Lt., H. and Power	$100	8	9†	234 —239	..	3 15 4
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5a	34 — 38	..	..
River Plate, Ord.	Stock	10	..	240 —250	..	4 0 0
Do. 6 % Non-Cum. Pref.	Do.	6	6	106 —111	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	102 —104	..	4 16 2
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	98 —100	..	4 10 0
Shawinigan Water, Capital	$100	5	5	137 —141	—3	3 10 11
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	106 —108	..	4 12 9
Do. 4½ % Per. Deb.	Stock	4½	4½	100¼ —102½	..	4 7 10
Toronto Power, 4½ % Deb.	Do.	4½	4½	99½ —101½	..	4 7 5
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	93½ — 96½	..	5 3 8
Victoria Falls Power, Pref.	1	11 7/32d.	17 3/32d.	1/16 — 1	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	103½ —105⅞	..	5 13 9

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	4	4½†	7⅜ — 7⅞ xd	..	5 14 3
Do. 5 % Deb. Red.	Stock	5	5	97 — 99	..	5 1 0
American Telep. & Teleg., Cap.	$100	8	8†	145 —147	..	5 8 10
Do. Collat. Trust	$1000	4	4	93½ — 95½	..	4 3 9
Anglo-American Telegraph	Stock	3	3	67 — 69	..	4 7 0
Do. 6 % Pref.	Do.	6	6	110½ —111½	..	5 7 8
Do. Def.	Do.	80/-	..	25½ — 26	..	5 15 5
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	5	7	8	7⅜ — 7⅞	..	5 3 3
Commercial Cable, Stlg. 4% Deb.	Stock	4	4	80½ — 82½	— ½	4 17 0
Cuba Telegraph	10	6	6†	8½ — 9½	— ½	6 6 4
Do. 10 % Pref.	10	10	10	16 — 17 xd	..	5 17 8
Direct Spanish Telegraph, Ord.	5	4	4†	3½ — 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	6½ — 7	..	7 2 10
Direct United States Cable	10	5	4	7 — 7⅛	— ⅛	6 13 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	98½ —100½	..	4 9 7
Western Telegraph, Ord. Stock	Stock	7	7†	132 —135	+1	5 3 8
Do. 8½ % Pref. Stock	Do.	8½	8½	77 — 79	+ ½	4 8 7
Do. 4 % Mort. Deb.	Do.	4	4	95½ — 97½	..	4 2 1
Eastern Extension	10	7	7†	13 — 13½	+ ½	5 3 8
Do. 4 % Deb.	Stock	4	4	96 — 98	—1	4 1 8
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	98 — 101	..	3 19 8
Globe Telegraph and Trust	10	6	6†	10⅜ — 11½	..	5 7 7
Do. 6 % Pref.	10	6	6	12⅜ — 13½	..	4 11 4
Great Northern Telegraph	10	18	18	28½ — 29½	..	6 2 0
Indo-European Telegraph	25	18	5†	55½ — 57½	— ½	5 14 0
Mackay Companies Common	$100	5	5†	86 — 89	..	5 12 4
Do. 4 % Cum. Pref.	$100	4	4	69 — 73	..	5 9 7
Marconi's Wireless Telegraph	1	20	..	5⅛ — 5⅜	— 1/16	3 17 2
Do. 7 % Cum. Partic. Pref.	1	17	..	4⅜ — 4⅝	— ⅛	3 13 7
Monte Video Telephone, Ord.	1	6	6†	1 3/32 — 1 5/32	..	5 13 0
Do. 5 % Pref.	1	5	5	3/32 — 5/32	..	5 14 8
National Telephone Def.	Stock	6	..	154½ —156½	+8	..
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	98½ — 99½	..	4 10 8
Oriental Telep. and Elec.	1	8	6†	1 3/32 — 1 5/32	+ 3/32	4 9 10
Do. 6 % Cum. Pref.	1	6	6	1 1/16 — 1 3/16	..	5 0 10
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 9 0
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 —100	..	4 0 0
Reuter's	10	10	10†	10⅞ — 11⅜	..	8 16 2
Submarine Cables Trust	Cert.	6	6	126 —129	..	4 13 0
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99½ —101½	..	4 8 8
United River Plate Telephone	5	8	..	7 5/16 — 7 7/16	+ 1/16	5 5 10
Do. 5 % Cum. Pref.	5	5	5	5⅜ — 5⅝	..	4 8 11
West Coast of America	2½	2½	..	1⅛ — 1⅜	..	3 18 5
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	10	2½	1½†	3⅜ — 3 7/16	..	..
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10⅝	..	5 14 3
Do. 6 % Cum. 2nd Pref.	10	6	6	9½ — 10	..	6 0 0
Do. 5 % Debs.	..	100	5	5	101½ —103½	..	4 16 7
Western Telegraph, Ltd.	10	7	7†	13⅜ — 13⅝	+ ⅛	5 1 10
Do. 4 % Deb.	Stock	4	4	95½ — 97½	..	4 2 1
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	98 —101	..	4 9 1

* Unless otherwise stated, all shares are fully paid. a Paid in deferred interest warrants. † Interim Dividend. ‡ 8s. in Funded Dividend Certs

CONTINUED ON NEXT PAGE.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 3rd.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	* 1	Nil	Nil	3/16 — 5/16	..	Nil
Do. 5 % Pref.	1	5	5	11/16 — 13/16	..	6 8 1
Do. 4½ % Deb.	100	4½	4½	76 — 81	..	5 11 1
Brit. Elec. Trac., 6 % Pref.	100	..	..	11⅛ — 13⅛	+ ⅛	..
Do. Do. Deferred	100	..	..	5 — 7	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	90 — 93	+1	6 9 0
Do. 7 % Non-Cum. Pr'f.	100	..	..	38 — 41	+2	..
Do. 5 % Perp. Deb.	100	5	5	92 — 96	..	5 4 2
Do. 4½ % 2nd Deb.	100	4½	4½	77 — 81	..	5 7 2
Central London Railway, Ord.	100	8	8†	80 — 82	—1	3 18 2
Do. Pref.	100	4	4	81 — 83	..	4 16 5
Do. Def.	100	2	..	80 — 82	—1	2 8 9
Do. 4 % Deb.	100	4	4	100 —102	..	3 18 5
City & South London, Ord.	100	1⅜	1½†	37⅛ — 38⅛	— ⅛	3 11 5
Do. 5 % Pref., 1891	100	5	5	108 —110	+1	4 10 11
Do. Do. 1896	100	5	5	108 —110	+1	4 10 11
Do. Do. 1901	100	5	5	108 —110	+1	4 10 11
Do. Do. 1903	100	5	5	108 —110	+1	4 10 11
Do. 4 % Deb.	100	4	4	98 —100	+1	4 0 0
Dublin United Trams, 6 % Pref.	10	6	6	12 — 13	..	4 12 4
Great Northern & City, Pr'f. Ord	10	Nil	Nil	2⅛ — 2⅜	..	Nil
Hastings Trams, 6 % Pref.	1	6	6†	1⅝ — 2⅜	..	8 6 8
Do. 4½ % Deb.	100	4½	4½	69 — 74	..	6 1 7
Isle of Thanet Trams, 5 % Pref.	5	2½	..	2⅛ — 2⅜	..	4 11 0
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	81 — 83	..	6 0 6
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	..	5⅛ — 5⅜	— ⅛	..
Do. 4 % Deb.	100	4	4	74 — 77	+1½	5 3 11

NAME.	Stock or Share.	Dividends for 1911.	Dividends for 1912.	Closing Quotations Dec. 3rd.	Rise + or Fall —	Present Yield p.c. £ s. d.
Metropolitan Railway Consol.	* 100	1½	1½†	55⅜ — 56½	—1	2 17 9
Do. Surplus Lands	100	2⅛	2⅛†	62 — 64	..	4 6 0
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 16 11
Do. 3½ % Pref.	100	3½	3½	86 — 88	+1	3 19 7
Do. 3½ % Con. Pref.	100	3½	3½	84 — 86	..	4 1 5
Metropolitan District Ord.	100	Nil	Nil	42¼ — 42⅜	+2⅛	Nil
Do. 6 % Deb.	100	6	6	141 —143	..	4 4 0
Do. 4 % Deb.	100	4	4	94 — 96	..	4 3 4
Do. 4 % Prior Lien	100	4	4	98 —100	..	4 0 0
Do. 4½ % First Pref.	100	4½	4½	88 — 90	..	5 0 0
Do. 3½ % Gtd.	100	3½	3½	76 — 78	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5	5†	1⅛ — 1⅜	— ⅛	5 16 0
Do. Def.	1	Nil	..	1/16 — 3/16	+ 1/16	Nil
Do. 5 % Pref.	1	5	5	7/16 — 9/16	— 1/16	5 6 8
Do. 4½ % Deb.	100	4½	4½	93 — 96	..	4 14 9
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Potteries, Ord.	1	3½	..	5/16 — 7/16	+ 1/16	..
Do. 5 % Pref.	1	5	5	13/16 — 15/16	..	6 19 0
Do. 4½ % Deb.	100	4½	4½	85 — 88	..	5 2 8
South Metro. Trams, 6 % Pref.	1	6	..	1⅛ — 1⅜	..	7 7 8
Do. 4 % Deb.	100	4	4	67 — 72	..	5 11 1
Underground Elec. Railways	10	..	..	4⅜ — 4⅝	+ ⅛	Nil
Do. "A"	1/-	..	..	3/16 — 5/16	..	..
Do. 6% First Cum. Inc. Deb.	100	..	6	112 —114	..	5 5 3
Do. 4½ % Bonds	100	4½	4½	100 —102	+1	4 8 3
Do. 6 % Income	100	1½	£2	91 — 93	+3	..
Yorkshire (West Riding), Ord.	5	Nil	..	1/4 — 3/4	..	Nil
Do. 6 % Pref.	5	3	..	3 — 3½	..	4 5 0
Do. 4½ % Deb.	100	4½	4½	79 — 83	..	5 8 1

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5½	4 13/16 — 5 1/16	..	5 3 6
Do. 2nd Pref.	5	5½	5½	4 11/16 — 4 15/16	..	5 17 4
Do. 4 % Deb.	100	4	4	93 — 95	..	4 4 3
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	97 — 99 xd	..	5 1 0
Auckland Trams, 5 % Deb.	100	5	5	103½—105½	..	4 14 9
Bombay Elec. S. & Trams, Pref.	10	6	6	11 — 12	..	5 0 0
Do. 4½ % Deb.	100	4½	4½	98 —100	..	4 10 0
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brazilian Traction Light and Power	$100	..	..	94⅛—95⅛	+ ⅛	..
Brisbane Trams Invt., Ord.	5	8	8†	7 1/16 — 7 5/16	..	5 9 5
Do. 5 % Pref.	5	5	5	4⅜ — 5⅛	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	100½—103½	..	4 7 0
B. Columbia Elec. Rly., Def.	100	8	..	144 —149	..	5 7 5
Do. Pref. Ord.	100	6	6	118 —122	..	4 18 4
Do. 5 % Pref.	100	5	5	107 —110	..	4 11 0
Do. 4½ % 1st Mort. Deb.	40	4½	4½	98 —101	..	4 9 1
Do. 4½ % Vancouver Deb.	100	4½	4½	103 —105	..	4 5 9
Do. 4½ % Con. Deb.	100	4½	4½	100 —103	..	4 2 6
Calcutta Trams, Ord.	5	7	5†	5 7/16 — 6⅜	..	5 9 10
Do. 5 % Pref.	5	5	5	4 13/16 — 5 1/16	..	4 16 5
Do. 4½ % Deb.	100	4½	4½	99 —102	..	4 8 3
Cape Electric Trams	1	2½	..	3/16 — 5/16	..	..
City Buenos Aires Trams (1904)	5	5	5†	5 1/16 — 5 3/16	..	4 8 0
Do. 4 % Deb.	100	5	5	99 —102	..	4 18 0
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	93 — 97	..	5 2 1
Havana Elec. Rly., 5 % Bonds	$1000	5	5	99 —103	..	4 17 1
Kalgoorlie Elec. Trams	1	Nil	..	3/16 — 5/16	..	Nil
Do. 5 % A Deb.	100	5	5	86 — 91	..	5 10 0
Do. 6 % B Deb.	100	6	3	35 — 43	..	..
La Plata Elec. Trms, Ord.	1	Nil	..	3/16 — 5/16	..	..
Do. Pref.	1	5	..	13/16 — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	6	6†	1 — 1¼	..	4 16 0
Do. 6 % Pref.	1	6	6	1 — 1¼	..	4 16 0
Do. 5 % Deb.	100	5	5	98 — 97	..	5 3 1
Madras Elec. Tr. (1904), Deb.	100	5	5	100 —102	..	4 18 0
Manaos Trams & Lt., 1st Deb.	100	5	5	89 — 92	— 1	5 8 8
Manila Elec. R. and Lig., Bonds	$1000	6	5	100½—102½	..	4 17 7
Mexico Trams Com.	$100	7	7†	113 —118	+2	5 18 8
Do. Gen. Con. 5 % Bonds	..	5	5	95½ — 97½	..	5 2 7
Do. 6 % Bonds	100	6	6	101 —103	..	5 16 6
Para Elec. Rlys. & Lt., Ord.	5	10	10†	7⅜ — 7⅝	..	6 11 2
Do. 6 % Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	96½ — 98½	..	5 1 6
Perth (W.A.) Elec. Tr., Ord.	1	5	5½	1 3/32 — 1 1/16 xd	..	3 14 5
Do. 5 % 1st. Deb.	100	5	5	99 —102	..	4 18 0
Rangoon El. Tr. & Sup., Pref.	5	6	6	5½ — 6	..	5 0 0
Do. 4½ % 1st Deb.	100	4½	4½	99 —101	..	4 9 1
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	101½—103½	..	4 16 7
Do. 5 % Mort. Bonds	100	5	5	97 — 99	+ ½	5 1 0
Sao Paulo Tram, Lt. and P., 5 % 1st Deb.	$500	5	5	102 —104 xd	..	4 16 2
Singapore Trams, 5 % Deb.	100	5	5	82 — 85	..	5 17 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	96 — 98	..	5 2 0
Un. Elec. Trams Monte Video	5	7	..	5⅝ — 6⅛	..	5 14 3
Do. 6 % Pref.	5	6	..	5 — 5½	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	99 —102	..	4 18 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	100 —103	..	4 7 5

MANUFACTURING COMPANIES.

Aron, Ord.	1	6	..	3/16 — 5/16	..	8 0 0
Do. 6 % Pref.	1	6	6	11/16 — 13/16	..	7 7 8
Babcock & Wilcox	1	28	14†	3 — 3½	..	4 6 2
Do. Pref.	1	6	6	1 7/16 — 1 9/16	..	8 16 10
British Aluminium, Ord.	1	Nil	..	1/16 — 1/8	..	..
Do. 6 % Cum. Pref.	1	Nil	..	3/16 — 5/16	..	..
Do. 5 % Prior Lien Debs.	100	5	5	92 — 95	..	5 5 2
Do. Deb. Stk.	100	5	5	86 — 89	..	5 12 4
B.I. & Helsby Cables	5	10	8†	7⅜ — 8	..	6 5 0
Do. Pref.	5	6	6	5 7/16 — 6⅜	..	4 14 1
Do. Deb.	100	4½	4½	103 —105	+1	4 5 9
British Thomson-Houston, Deb.	100	4½	4½	94 — 96	..	4 13 9
British Westinghouse, Pref.	8	Nil	Nil	1/2 — 3/4	..	Nil
Do. Deb.	100	4	4	59 — 62	..	6 9 1
Do. 6 % Prior Lien	100	6	6	100 —103	..	5 16 6
Browett, Lindley, Ord.	1	..	..	2/- —3/-	..	Nil
Do. Pref.	1	..	..	4/6 —5/-	..	Nil
Brush, 7 % Pref.	2	Nil	Nil	0 — ¼	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	75 — 80	..	6 5 0
Do. 4½ % Deb.	100	4½	4½	47 — 52	..	8 13 2
Do. 4½ % Second Deb.	100	4½	4½	30 — 34	..	13 4 8
Callender's Cable	5	15	10†	10⅛ — 11⅛	..	6 13 4
Do. Pref.	5	5	5	4⅞ — 5⅛	..	4 17 7
Do. Deb.	100	4½	4½	99⅛—101⅛	..	4 8 8
Castner-Kellner	1	20	20	3 1/16 — 3 3/16 xd	..	5 4 11
Do. Deb.	100	4½	4½	105 —108	..	4 3 4
Crompton & Co.	8	Nil	..	1/16 — 3/16	..	Nil
Do. Deb.	100	5	5	56 — 66	..	7 11 6
Dick, Kerr	1	5	Nil	1/16 — 3/32	..	..
Do. Pref.	1	6	6	1/16 — 3/32	..	6 8 0
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Edison & Swan, A, £3 paid	5	Nil	..	1/16 — 3/32	..	Nil
Do. fully paid	5	Nil	..	1½ — 2	..	Nil
Do. 4 % Deb.	100	4	4	65 — 69	..	5 16 0
Do. 5 % Second Deb.	100	5	5	72 — 75	..	6 18 4
Electric Construction	2	2½	3½	1/16 — 1 1/16	..	7 1 4
Do. Pref.	2	7	7	1½ — 2	..	7 0 0
Greenwood & Batley, Pref.	10	7	7	7½ — 8	..	8 5 8
Do. Deb.	100	5	5	92 — 94	..	5 4 2
General Electric, Pref.	10	5	5	10 — 11	..	..
Do. Deb.	100	4	4	90 — 95	..	4 4 3
Henley's, Ord.	5	17	5†	12½ — 13	..	6 10 9
Do. Pref.	5	4½	4½	4 13/16 — 5 1/16	..	4 9 0
Do. Deb.	100	4½	4½	101 —102 xd	..	4 7 5
India-Rubber, G. & T.	10	..	..	8⅛ — 9⅛	..	..
Do. Pref.	10	5	5	9½ — 10⅜	..	4 17 7
Telegraph Construction	12	17½	5†	35⅛ — 37½	..	5 10 0
Do. Deb.	100	4	4	97 —100	..	4 0 0
Willans & Robinson	1	Nil	..	1/16 — 1/8	—1/16	Nil
Do. Pref.	5	Nil	..	1/4 — 3/4	— ⅛	Nil
Do. Deb.	100	4	4	57 — 59 xd	..	6 15 7

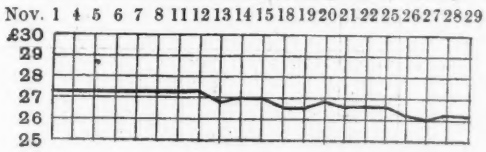
* Unless otherwise stated, all shares are fully paid. † Interim dividend.

Bank rate of Discount 5 per cent., October 17th, 1912.

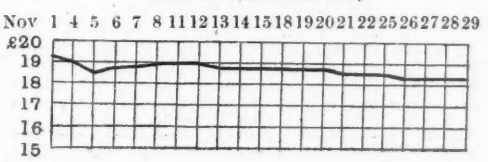
METAL MARKET.

Fluctuations in November.

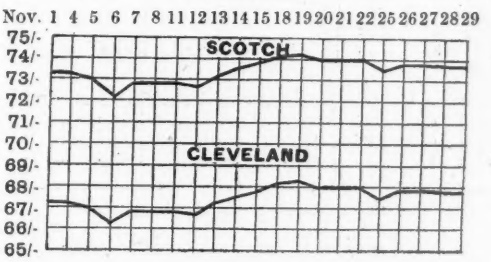
SPELTER (G.O.B's.).



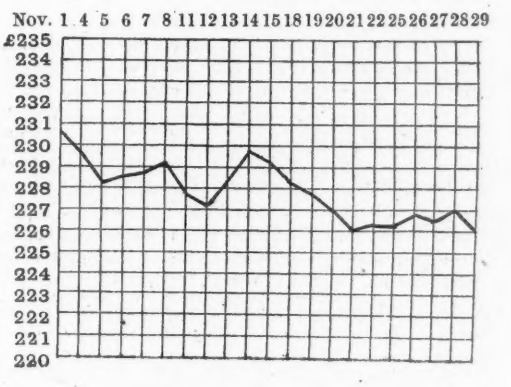
LEAD (ENGLISH).



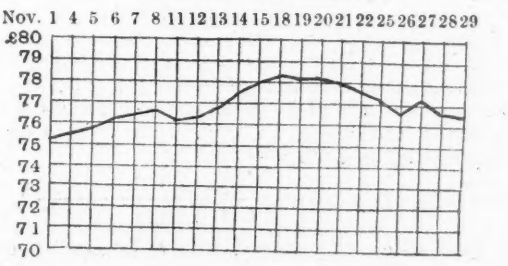
IRON.



TIN.



COPPER (G.M.B's.).



Dinner and Concert.—The employés of the London Branch of the Bosch Magneto Co., Ltd., opened their "Social" season on Friday last at the Horseshoe Hotel, Tottenham Court Road, W., where over 70 sat down to dinner. The dinner was followed by a concert. The chair was occupied by Mr. Chas. Gorick, and among those who rendered entertainment were Messrs. Hoffmann, Toomey, Povey, Richmond, Vinson-Monckley, Gorick, Revell, Beckitt, Deubelbeis, McAlpine, Parish, Partridge, and Herr Schmidt. Mr. H. F. Warren accompanied at the Piano. The toast of the evening, that of the "Management," was proposed by Mr. Chas. Godfree. Mr. A. Bennett responded. Mr. F. E. Barker acted as hon. sec. The ball and whist drive is to take place on January 3rd, at the Abercorn Rooms, and Mr. Gorick is now busy arranging for the event.

THE LOADING OF SUBMARINE TELEPHONE CABLES.

A Comparison between Coil-Loaded and Continuously-Loaded Cables.

By J. G. HILL.

(*Continued from page* 894.)

The following way of looking at the relative efficiency of cable circuits may be of interest. In the case of any circuit, loaded or unloaded, the following equation holds good—

$$\beta = \sqrt{\tfrac{1}{2}\sqrt{(R^2+p^2L^2)(S^2+p^2K^2)}+\tfrac{1}{2}(RS-p^2KL)}, \quad (5)$$

where $p = 2\pi$ times the frequency n. The expression may be written—

$$\beta = \sqrt{\tfrac{1}{2}pKR\left(\sqrt{(1+p^2L^2/R^2)(1+S^2/p^2K^2)}+S/pK-pL/R\right)}.$$

Now S^2/p^2K^2 may be neglected, and the rearranged formula becomes—

$$\beta = \sqrt{\tfrac{1}{2}pKR\left(\frac{\sqrt{p^2L^2+R^2}-pL}{R}+S/pK\right)}. \quad (6)$$

If we write—

$$\sqrt{\tfrac{1}{2}p\left(\frac{\sqrt{R^2+p^2L^2}-pL}{R}+S/pK\right)} = \sqrt{A},$$

the complete formula for an unloaded circuit may be written

$$\beta = \sqrt{KRA}, \quad (7)$$

and the ratio of improvement obtained by loading a given circuit having this β before loading may be seen from the expression—

$$\sqrt{A/A_1} = \frac{\beta \text{ unloaded}}{\beta_1 (\text{same cable circuit loaded for minimum } \beta)}.$$

The value of L per km. may be calculated as explained further on, and it will not exceed 1 mh. per kilometre in an unloaded gutta-percha cable circuit. Also $p = 2\pi \times 1{,}000$, and therefore the above expression $\sqrt{A}$ in the case of modified gutta-percha may be reduced to—

$$\sqrt{A} = 56\sqrt{\left(\frac{\sqrt{R^2+39{\cdot}5}-6{\cdot}28}{R}+0{\cdot}002\right)}.$$

If the case of a conductor having a loop resistance of 2 ω per km. be examined (weighing a little over 600 lb. per naut) the formula gives $\sqrt{A} = 22$, and

$$\sqrt{A/A_1} = 22/\sqrt{72} = 2{\cdot}6;$$

i.e., the speaking range brought about by coil-loading would be 2·6 times the original cable length.

If such a cable were loaded by the continuous loading method, we should have—

$$\sqrt{A/A_2} = 22/\sqrt{122} = 2 \text{ (nearly)}.$$

So that in this case the speaking range is doubled.

If the resistance R is very high, as in very small gauge cable, the expression—

$$A = 56\sqrt{\frac{\sqrt{R^2+39{\cdot}5}-6{\cdot}28}{R}+S/pK}$$

is modified. In that case—

$$\sqrt{\frac{\sqrt{R^2+39{\cdot}5}-6{\cdot}28}{R}}$$

converges towards 1, and S/pK becomes negligible. So that $\sqrt{A} = 56$, and $\sqrt{A/A_1} = 56/8{\cdot}5 = 6{\cdot}6$.

Theoretically, therefore, such a circuit could be increased in speaking range from 1 to 6·6 times the original length. The amount of inductance required, however, for this purpose would give too high an impedance, and the coils would require to be spaced too close together for practical purposes.

TABLE II.—Best Possible Inductance and Minimum "β" in Circuits with Different Resistances and Fixed Capacity = ·09 mf. per km. at 1,000 Cycles per Second.

Coil-Loaded Cables.—Modified G.P.

Per naut.								Per kilometre.					
Cond. R.	Coil R_1	S/K.	R_1/L.	K.	L.	β_m†	$\sqrt{L/K}$.*	Cond. R.	Coil R_1.	K.	L.	β_m.†	$\sqrt{L/K}$.*
ohms.	ohms.			farads.	henrys.			ohms.	ohms.	farads.	henrys.		
3·71	3·12	12	60	1·67 × 10^{-7}	52 × 10^{-3}	6·68 × 10^{-3}	558	2	1·68	9 × 10^{-8}	28 × 10^{-3}	3·6 × 10^{-3}	558
7·42	6·18	12	60	1·67 ,,	103 ,,	9·46 ,,	784	4	3·36	9 ,,	56 ,,	5·1 ,,	784
11·13	9·3	12	60	1·67 ,,	155 ,,	11·55 ,,	963	6	4·98	9 ,,	83 ,,	6·23 ,,	963
14·84	12·36	12	60	1·67 ,,	206 ,,	13·34 ,,	1,111	8	6·60	9 ,,	110 ,,	7·20 ,,	1,111
Ordinary G.P.													
3·71	1·26	120	60	1·67 × 10^{-7}	21 × 10^{-3}	10·55 × 10^{-3}	353	2	·66	9 × 10^{-8}	11 × 10^{-3}	5·69 × 10^{-3}	353
7·42	2·46	120	60	1·67 ,,	41 ,,	14·93 ,,	495	4	1·32	9 ,,	22 ,,	8·05 ,,	495
11·13	3·72	120	60	1·67 ,,	62 ,,	18·27 ,,	604	6	1·98	9 ,,	33 ,,	9·85 ,,	604
14·84	4·92	120	60	1·67 ,,	82 ,,	21·12 ,,	701	8	2·64	9 ,,	44 ,,	11·38 ,,	701

Continuously-Loaded Cables.—Modified G.P.

Per naut.								Per kilometre.					
Cond. R.	Added R_2.	S/K.	R_2/L.	K.	L.	β_m.†	$\sqrt{L/K}$.*	Cond. R.	Added R_2.	K.	L.	β_m.†	$\sqrt{L/K}$.*
ohms.	ohms.			farads.	henrys.			ohms.	ohms.	farads.	henrys.		
3·71	3·3	12	110	1·67 × 10^{-7}	30 × 10^{-3}	8·7 × 10^{-3}	424	2	1·76	9 × 10^{-8}	16 × 10^{-3}	4·69 × 10^{-3}	424
7·42	6·71	12	110	1·67 ,,	61 ,,	12·35 ,,	604	4	3·63	9 ,,	33 ,,	6·66 ,,	604
11·13	10·0	12	110	1·67 ,,	91 ,,	15·06 ,,	738	6	5·39	9 ,,	49 ,,	8·12 ,,	738
14·84	13·42	12	110	1·67 ,,	122 ,,	17·4 ,,	852	8	6·96	9 ,,	66 ,,	9·38 ,,	852
Ordinary G.P.													
3·71	1·76	120	110	1·67 × 10^{-7}	16 × 10^{-3}	11·93 × 10^{-3}	310	2	·96	9 × 10^{-8}	8·7 × 10^{-3}	6·43 × 10^{-3}	310
7·42	3·55	120	110	1·67 ,,	32·3 ,,	16·88 ,,	440	4	1·91	9 ,,	17·4 ,,	9·10 ,,	440
11·13	5·32	120	110	1·67 ,,	18·4 ,,	20·59 ,,	538	6	2·87	9 ,,	26·1 ,,	11·1 ,,	538
14·84	7·1	120	110	1·67 ,,	64·5 ,,	23·89 ,,	622	8	3·82	9 ,,	34·8 ,,	12·88 ,,	622

* Characteristic impedance. † Minimum attenuation constant.

One further case of simplification may be of interest. The formula (1)—

$$\frac{R + (R_1/L + S/K)\,L}{2}\sqrt{K/L} = \beta$$

is true for any loaded circuit with sufficient inductance, whereas the expression (4) $\beta_m = \sqrt{K\,R\,A_1}$ gives the β where the best inductance is used. Dividing (1) by (4), we get—

$$\beta/\beta_m = \frac{\sqrt{R/L\,A_1} + \sqrt{L\,A_1/R}}{2}. \qquad (8)$$

By substituting the value of L from (2), this becomes—

$$\beta/\beta_m = \frac{\sqrt{L/L_1} + \sqrt{L_1/L}}{2}, \qquad (9)$$

and if p_v is the percentage of variation from the minimum β, then—

$$p_v = 50\,[(\sqrt{L/L_1} + \sqrt{L_1/L}) - 2], \qquad (10)$$

where L is now the inductance required for a minimum β, and L_1 is any inductance selected for loading purposes. As an example, consider the β of the cable in Table II, having a resistance of 14·8 ω per naut. When fully loaded with 206 mh., the β is given as 13·34 × 10^{-3}. The same cable in Table III is loaded with only 103 mh., and the β is 14·17 × 10^{-3}. By inserting the above values of L in formula (10), we get—

$$p_v = 6{\cdot}05,$$

i.e., by only taking half the best possible loading, the β obtained varies 6 per cent. from that obtained with the best possible loading (it is, of course, higher), and if 6 per cent. of 14·17 be added to 13·34, the two sets of figures agree very nearly. If, instead of taking only half the best inductance, the latter inductance be doubled, the equation gives the same result. In the same conditions (*i.e.*, with the same resistance, capacity and leakance), the β of the continuously-loaded cable is 57 per cent. higher than the minimum β when loaded with 0·087 mh. per kilometre.

By means of the various formulæ given, Tables II, III and V have been worked out. Tables II and III show the minimum β per naut and per kilometre for circuits of various resistances, and with the same fixed capacity in each case.

Table II assumes that the minimum β can in all cases be obtained. It is of theoretical interest, but in practice the best β cannot always be obtained. It will be seen that the ratio $\sqrt{A_1/A_2}$ holds good.

Table III differs from the preceding one, inasmuch as inductances which are known to be commercially practicable are adhered to, but in other respects the constants are the same as in Table II.

In M. Devaux Charbonnel's article similar, but not identical, tables are dealt with, and 0·087 mh. per kilometre is stated by that writer to be the best L which can be obtained without great difficulty and expense in continuously-loaded cables. This statement must not, of course, be taken too literally as a rigid limit, but it affords a convenient and accepted basis for comparison. As will be shown later, however, it is not economical to provide all cables of equal capacity, and therefore Table V has been prepared. This table gives electrical details of cables of both types, approximately made up on the basis of using the least amount of gutta-percha consistent with safety, to keep down expense. Details of continuously-loaded cables having the *same* capacity as the coil-loaded ones are added for interest.

Before applying the data in these tables to obtain the cost of the two types of cables, *i.e.*, the cost of obtaining a given β in each type, it will be necessary to examine the formulæ which permit of the inductance and added resistance of continuously-loaded cables being calculated, seeing that from these details the design of such cables must be determined.

The amount of inductance added to a cable by a given quantity of iron is given by the following formula, which is developed and proved in Prof. Breisig's "Theoretische Telegraphie," page 322 :—

$$L = 4l\left(\log 2\,d/r + \tfrac{1}{4} + \mu\frac{\pi\,t^2}{2\,(2r+t)\,(t+a)\,(1+\alpha)}\right), \qquad (11)$$

where l is the length in cm., d is the distance between the centres of the conductors, r is the radius of the conductor, μ is the permeability of the iron, t is the thickness of the iron winding, and a and α are coefficients which account for energy losses.

If these losses be neglected the formula becomes—

$$L = 4\,l\left(\log 2\,d/r + \tfrac{1}{4} + \frac{\mu\,\pi\,t^2}{2\,(2\,r + t)\,t}\right),$$

and this formula was found in practice to hold approximately good by M. Devaux Charbonnel. The difference in the two formulæ may, however, amount to several per cent.

The first part of the expression, viz., 4 L (log 2 d/r + $\frac{1}{4}$) accounts for the natural inductance of the circuit apart from the iron, and the added inductance is therefore—

TABLE III.—Inductances Commercially Used (or Obtainable) and Corresponding "β," in Circuits with Different Resistances and Fixed Capacity = ·09 mf. per km. at 1,000 Cycles per Second.

Coil-loaded Cables.—Modified G.P.

Per naut.								Per kilometre.					
Cond. R.	Coil R_1	S/K.	R_1/L.	K.	L.	β.†	$\sqrt{L/K}$.*	Cond. R.	Coil. R_1.	K.	L.	β.†	$\sqrt{L/K}$.*
ohms.	ohms.			farads.	henrys.			ohms.	ohms.	farads.	henrys.		
3·71	3·12	12	60	1·67 × 10^{-7}	52 × 10^{-3}	6·68 × 10^{-3}	558	2	1·68	9 × 10^{-6}	28 × 10^{-3}	3·6 × 10^{-3}	558
7·42	6·18	12	60	1·67 ,,	103 ,,	9·46 ,,	784	4	3·36	9 ,,	56 ,,	5·1 ,,	784
11·13	6·18	12	60	1·67 ,,	103 ,,	11·81 ,,	784	6	3·36	9 ,,	56 ,,	6·37 ,,	784
14·84	6·18	12	60	1·67 ,,	103 ,,	14·17 ,,	784	8	3·36	9 ,,	56 ,,	7·64 ,,	784
Ordinary G.P.													
3·71	1·26	120	60	1·67 × 10^{-7}	21 × 10^{-3}	10·55 × 10^{-3}	353	2	·66	9 × 10^{-6}	11 × 10^{-3}	5·69 × 10^{-3}	353
7·42	2·46	120	60	1·67 ,,	41 ,,	14·93 ,,	495	4	1·32	9 ,,	22 ,,	8·05 ,,	495
11·13	3·72	120	60	1·67 ,,	62 ,,	18·27 ,,	604	6	1·98	9 ,,	33 ,,	9·85 ,,	604
14·84	4·92	120	60	1·67 ,,	82 ,,	21·12 ,,	701	8	2·64	9 ,,	44 ,,	11·38 ,,	701

Continuously-loaded Cables.—Modified G.P.

Per naut.								Per kilometre.					
Cond. R.	Added R_2.	S/K.	R_2/L.	K.	L.	β.†	$\sqrt{L/K}$.*	Cond. R.	Added R_2.	K.	L.	β.†	$\sqrt{L/K}$.*
ohms.	ohms.			farads.	henrys.			ohms.	ohms.	farads.	henrys.		
3·71	1·76	12	110	1·67 × 10^{-7}	16 × 10^{-3}	9·15 × 10^{-3}	310	2	·96	9 × 10^{-6}	8·7 × 10^{-3}	4·93 × 10^{-3}	310
7·42	1·76	12	110	1·67 ,,	16 ,,	15·1 ,,	310	4	·96	9 ,,	8·7 ,,	8·15 ,,	310
11·13	1·76	12	110	1·67 ,,	16 ,,	21·1 ,,	310	6	·96	9 ,,	8·7 ,,	11·37 ,,	310
14·84	1·76	12	110	1·67 ,,	16 ,,	27·1 ,,	310	8	·96	9 ,,	8·7 ,,	14·59 ,,	310
Ordinary G.P.													
3·71	1·76	120	110	1·67 × 10^{-7}	16 × 10^{-3}	11·93 × 10^{-3}	310	2	·96	9 × 10^{-6}	8·7 × 10^{-3}	6·43 × 10^{-3}	310
7·42	1·76	120	110	1·67 ,,	16 ,,	17·86 ,,	310	4	·96	9 ,,	8·7 ,,	9·63 ,,	310
11·13	1·76	120	110	1·67 ,,	16 ,,	23·82 ,,	310	6	·96	9 ,,	8·7 ,,	12·84 ,,	310
14·84	1·76	120	110	1·67 ,,	16 ,,	29·77 ,,	310	8	·96	9 ,,	8·7 ,,	16·05 ,,	310

* Characteristic impedance. † Attenuation constant.

$$L = 4\,l\left(\mu\,\frac{\pi\,t}{2\,(2\,r+t)}\right). \qquad (12)$$

Call $2\,r$ d (the diameter of the wire), and we get—

$$L = \mu\,2\,\pi\,l\,t/(d+t). \qquad (13)$$

If the thickness of iron be made up by p windings, each of thickness t, this becomes $L = 2\,\pi\,\mu\,l\,p\,t/(d+pt)$, but—

$$p\,t/(d+p\,t) = \frac{1}{d/pt+1}, \qquad (14)$$

and from this it may be seen that if the ratio d/pt is kept constant, L will be unaltered (if the natural inductance of the circuit is unaltered). On that assumption, it is evident that, in order to obtain the same value of inductance in conductors of different diameters, the thickness of the iron winding ($p\,t$) must be increased in the same proportion as the diameter of the copper conductor is increased. The expression given is in absolute units, and to bring it to henrys per km. we have—

$$L = 10^{-4} \times 2\,\pi\,\mu \times p\,t/(d+p\,t). \qquad (15)$$

The figure to be taken for permeability, μ, is a somewhat doubtful quantity. It is sometimes taken as 120, but M. Devaux Charbonnel finds 110 to be suitable with the shortened formula, whilst some other experimenters find a less value still. It depends largely upon the material used. The increase in resistance brought about by the insertion of inductance in continuously-loaded cables has been made the subject of exhaustive research by Prof. Larsen, and Prof. Breisig, on page 323 of "Theoretische Telegraphie," gives the following formula after consideration of Larsen's work—

$$R_2 = \frac{S_e\,\pi^2\,\mu^2\,\omega^2\,t^4}{4\,(2\,r+t)\,(t+a)\,(1+\alpha)^2}, \qquad (16)$$

where S_e is the specific conductivity in C.G.S. units of the iron, t is the thickness of the iron winding, r is the radius of the wire on which it is wound, $\omega = 2\,\pi\,n$, μ is the permeability, and a and α are correcting factors, as in (11). Neglecting these losses, we get—

$$R_2 = \frac{S_e\,\pi^2\,\mu^2\,\omega^2\,t^3}{4\,(2\,r+t)}.$$

Converting the specific conductivity S_e to specific resistance, $1/\rho$, and rearranging the formula, we get—

$$\frac{4\,\pi^4\,\mu^2\,n^2\,t^3}{4\,\rho\,(d+t)},$$

where d = the diameter of the conductor, and all the dimensions are in centimetres. To convert to ohms per kilometre we have—

$$R_2 = 10^{-4}\,\frac{\pi^4\,\mu^2\,n^2\,t^2}{\rho}\,.\,\frac{t}{d+t}. \qquad (17)$$

If millimetres are used in place of centimetres, and ρ is the resistance in ohms of a piece of iron 1 m. in length and 1 sq. mm. in cross-section, the formula becomes—

$$R_2 = 10^{-11}\,\frac{\pi^4\,\mu^2\,n^2\,t^2}{\rho}\,.\,\frac{t}{d+t}. \qquad (18)$$

It is often convenient to use the formula in this form.

(To be concluded.)

IMPROVEMENTS IN STEAM TURBO-GENERATORS.

According to the report of the Committee of the Association of Edison Illuminating Companies on steam turbines, based on information supplied by the manufacturers, a number of developments and improvements have been made recently in Westinghouse steam turbo-generator practice. Speed limits have been materially raised within recent times in both 25-cycle and 60-cycle practice. In 60-cycle practice generators of 5,000 K.V.A. rating at 3,600 R.P.M. have been built, which is considerably larger than had been completed a year ago. For machines larger than 5,000 K.V.A. four poles are being used up to approximately 20,000 K.V.A., whereas a 10,000-K.V.A. generator was about the largest machine yet built with four poles up to a year ago.

In 25-cycle practice, two-pole 1,500-R.P.M. machines are being built in sizes up to 20,000 K.V.A., and it is probable that the ratings will be carried up to 25,000 K.V.A. or possibly 30,000 K.V.A., although at these ratings other factors than the design of the turbo-generator itself may control the speed conditions. It may be said, however, that the generator itself is practicable up to 30,000 K.V.A. at 1,500 R.P.M. At 750 R.P.M. it is hard to say what the upper limit will be.

Some of the most radical improvements in the later high-speed turbo-generators have been in the methods of ventilation. In the older Westinghouse practice practically all the ventilation of the machine was through the air-gap between the rotor and stator. On the more recent machines, especially where the speed limits have been raised, it is not practicable to force sufficient cooling air

through the air-gap alone, and, therefore, additional ventilating channels are provided, and particular provision is made to prevent the currents of cooling air in the various paths from interfering with each other. In particular, the air passages are arranged with a view to cleaning them without dismantling the machine. Methods have also been devised for effectively cooling machines which have a great length compared with their diameter, and thus, it is claimed, a long machine of very high rating can be cooled as effectively as a short one, which has not usually been the case.

In the more recent machines of very large outputs, the rotor is made up of rolled-steel plates, which are rigidly and permanently clamped together, without a through shaft, to form the rotor body as a whole. This core is then suitably slotted for the rotor windings and for purposes of ventilation. The rotor windings consist of formed strap coils insulated with mica and asbestos, so that they can withstand an excessively high temperature under emergency conditions. Tests made with this type of insulation are said to have shown that it can successfully withstand temperatures higher than that of the melting point of tin solder.

As far as the records show, the manufacturer claims that there has never been a failure of the insulation with the Westinghouse mica-wound rotors due to deterioration by temperature, although a large number of such rotors have been employed in commercial service for a number of years.

On account of the higher speed limits with large machines, the methods of supplying cooling air have required more or less modification recently. For instance, a 60-cycle, four-pole machine of 20,000 K.V.A. rating will not have a materially larger diameter of rotor than a 10,000-K.V.A. machine of the same speed, although the amount of air required for cooling must be twice as great. In the 10,000-K.V.A. machine, a ventilating fan of the largest permissible dimensions may be installed directly on the rotor shaft, and the opening through such fan may be just sufficient to force in the required amount of ventilating air. Therefore, on the 20,000-K.V.A. machine it may be impracticable to obtain enough opening through a ventilating fan of the largest practical dimensions to allow the necessary air to be supplied to the machine, and hence some other method of ventilation becomes necessary or desirable. In consequence, on very large high-speed turbo-generators separate blowers are coming into use, these blowers being designed for any suitable speed and driven by electric motors. When a number of large turbo-generators are located in one station the ventilating fans can supply air to a large air chamber which opens to all the machines. This scheme is somewhat more economical than with blowers directly on the machines, as the fans can be operated at the most economical speed, and furthermore, if the fans are driven by motors with adjustable speed characteristics it is possible to vary the air pressure, depending upon the requirements of the load, so that further economy is thus obtained.

The Westinghouse Co. countenances the use of voltages up to 11,000 volts and 13,000 volts directly on the armature winding. Two principal difficulties incidental to the use of high voltage on the armature winding—namely, dangerous heating in that part of the copper buried in the core, and deterioration or "eating away" of the insulation by static discharges—have both been overcome by the use of mica insulation on the buried part of the coil, this insulation being put on individual turns as well as on the outside of the coil as a whole.

The end windings of Westinghouse machines, it is said, have been braced in a still more rigid manner than in the past, so that no danger is anticipated from dead short-circuits across the terminals of such machines without external reactance in series. The Westinghouse Co. designs its turbo-generators with a relatively large internal reactance, sufficient to prevent damage to the machine in case of a dead short-circuit across the terminals. This usually means from 12 to 18 times full-load current at the first instant of short-circuit. If for any reason outside the machine itself it is necessary or desirable to reduce still further the short-circuit current, it is recommended that this be done by means of external reactors. By this expedient a certain amount of adjustment is possible to meet external conditions, while the machine is able to protect itself regardless of the use of additional reactors.—*Electrical World.*

BRITISH TRADE IN RUSSIA.

By reason of past experience British firms are apt to look askance at the Russian market, fearing lest endeavours to extend their trade there may only result in loss to themselves. Such action in the past may have been warranted, but there is not, at the present time, the same reason for holding back from trade in Russia. Care is, of course, very necessary; "long" firms are by no means few, but if the trade is properly watched such firms can be avoided.

In a recent report, the British Consul at Moscow points out that Germany, France and the United States have made great advances in the market, while British trade has remained almost stationary. In extenuation of this unsatisfactory state of affairs it may be urged that figures are unreliable, and further, that certain branches of industry which once were practically British monopolies are now being exploited by foreign competitors. This is especially the case with spinning machinery, which at one time was almost entirely in the hands of British firms, partly because these firms led the way in this particular industry and partly because the managers of the numerous mills were nearly all Englishmen. Of late, however, other Continental firms have entered into the market. They supply cheaper machinery, and aided by their trade banks, can give longer credit than British firms are either able or willing to give. As, too, the number of British mill managers is decreasing, it is evident that, although British supremacy in this line is not likely to be threatened, British firms will no longer enjoy the monopoly which once was theirs. However, even allowing for the inaccuracy of figures and for the inevitable increase of competition, other reasons must be sought for the stagnation of British trade in the Russian market. First and foremost comes the question of credit. This has been a prominent feature in Consular reports for many years. It is quite true that it is impossible for British firms to grant the same credit as German and French firms which are supported by their local trade banks. In Moscow alone there are five German and two French trade banks. The Consul has long urged the necessity for creating a British trade bank in Moscow, which would assist British firms and help to supply information.

British firms, however, are at last beginning to realise the necessity of printing their catalogues in Russian and of sending young employés to learn the language, a policy which has also been advocated for years. It is quite a fallacy to suppose that British firms cannot do well in Russia or to state that the advantages which the Russian market affords are purely imaginary. Some trouble must be taken and concessions must be made to prevailing local customs, and British firms who have taken the trouble to study local conditions have invariably done well.

A factor which tells against British firms is the immense advantage which the foreign commercial traveller possesses over the British. English is hardly spoken at all in Russia, whereas German is widely known. The British traveller, as a rule, not only knows no Russian, but is also very often greatly handicapped by the fact that he is not generously treated by his firm as regards expenses as entertaining allowances, &c. In Russia most business is done "over the bar," and before a man can secure a big order he must, as the saying goes, "show his money." The German traveller, in addition to knowing the language of the country is more liberally treated in this matter.

Yet another factor that tells against British firms is the fact that they are often very badly represented by their agents. In Moscow there are often foreigners who will take an agency for a British firm simply for the sake of blocking sales. And yet there is no denying that, generally speaking, Russians all admit the superiority of British goods.

Imports from the United Kingdom into Russia consist mainly of machinery and raw and semi-manufactured articles. As Germany sends the same class of goods, competition is naturally very keen. To meet this competition satisfactorily, it is necessary that firms should have a knowledge of local conditions, that commercial travellers with a knowledge of Russian should visit the country with catalogues in Russian and prices in Russian money, and that credit should be given. As regards the last named, the Moscow Consul writes:—

"The credit system, which is the crux of the whole situation, is a sore point with British commercial journals, who point out very rightly that in urging the giving of long credit Consular reports are advocating what is, under present conditions, impracticable and impossible. British firms cannot compete with foreign firms, which are backed by their own trade banks. And until the United Kingdom establishes local banks in Russia, and falls into line in this respect with other nations, British firms will always be at a serious disadvantage as far as the Russian market is concerned."

In this connection, too, the Vice-Consul at Kharkoff recently wrote that British manufacturers are generally far too conservative with respect to credit, mainly, no doubt, because they have not studied the principles on which their Continental rivals do business. It is fighting them with one arm tied to refuse to adopt their most powerful weapon. Provided, of course, that the giving of credit is in the hands of experienced sales managers and is kept under proper control, outstanding accounts are regarded on the Continent as a very excellent asset, little below fluid capital in value. Without trade the manufacturing plant becomes dead capital, whereas when business is done as above, the outstanding debts are returned within a reasonable time and carry 5 to 6 per cent. interest. And when the manufacturer has not sufficient capital to finance the trade, Continental banks, or their London branches, are very willing to advance the money to firms of good standing for the support of this credit. It is not unusual for such credit to be given on open account, as an overdraft. But more often customers' six months' promissory notes, with the manufacturer's endorsement, are taken as a guarantee, these notes being renewable at six monthly intervals up to the termination of the sales' credit, in, say, 18 to 30 months. Thus not only is the trade extended without extra capital, and higher prices taken than is possible with cash payment, but an additional profit is made on the difference between the interest charged to the customer and the bank rate. British manufacturers and British bankers will find themselves forced to adopt the Continental methods of giving credit for the support of the export trade. If they do not do so, the British manufacturer will find himself elbowed aside when his Continental competitor sets seriously to work, and the British banker will see profitable banking operations, and especially the discounting of foreign bills, monopolised by Continental banks. Banks which discount the manufacturer's notes naturally obtain his other banking business also; and where a bank is largely concerned in financing a manufacturing company, it will frequently have a voice on the board of that company and influence the company's purchasing operations and trade for the benefit of other businesses in which the bank has an interest. The above remarks apply more particularly to makers of machinery.

The British Vice-Consul at Kertch points out that, in his district

German and Austro-Hungarian manufactures are everywhere noticeable, and one naturally wonders why they could not have been equally well supplied by British makers. The reason undoubtedly is that the foreign goods were offered to the purchaser and the British were not. The relatively high quality of British manufactures is undisputed, and the local feeling would seem to be that, given equal facilities for payment and delivery, the British article would be preferred on account of its unique reputation for quality and durability. One well-arranged catalogue in the Russian language has recently been received at the Vice-Consulate. This is an important step in the right direction, but when the foreign competitor's goods are offered personally by a competent commercial traveller, such documents, unassisted, are apt to be laid aside. The question of allowing long credit to certain classes of desirable customers should be carefully studied; the practice is now generally accepted and seems fraught with no special danger, always provided the necessary discrimination is exercised.

PROCEEDINGS OF INSTITUTIONS.

Earthed v. Unearthed Neutrals on Alternating-Current Systems.

By J. S. PECK, M.I.M.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS *at Manchester, November 19th, and London, November 28th*, 1912.)

IT is intended in this paper to discuss the various questions involved, and to show why under some conditions of operation it is becoming general practice to earth the neutral, while under others it may be advisable to operate with the neutral unearthed.

While several advantages may be claimed for the earthed neutral, there are but two which are really of any great value. These are:—

(*a*) The limiting of the voltage between line wires and earth.

(*b*) The possibility of cutting off any wire or feeder in the event of an earth upon it.

The chief objection to earthing is the fact that the system cannot be operated with an earth on any line wire.

It is well known that in an unearthed three-phase system, where the impedance of each phase to earth is equal, each of the three conductors assumes a potential above earth equal to 58 per cent. of the voltage between wires while the neutral point is at earth potential, but any difference in the impedance causes the potential of the neutral point to shift, bringing the phase having least impedance nearer to earth potential and raising the others to a potential correspondingly higher above earth. When one phase is earthed, it assumes earth potential, and the other phases reach full line potential above earth. When the potential of each phase to earth is the same, the charging current to earth will be equal in all phases, but when one phase is earthed the charging current to earth is increased by 73 per cent. in both of the unearthed phases, and all of this current will return to the generator through the earthed phase and will pass into the faulty wire at the earthed point.

Earthing the neutral means that this point is fixed at earth potential, and the three line wires are fixed at a potential 58 per cent. above earth.

If the neutral point is earthed through a resistance, and one phase is earthed, current flows through the neutral resistance, and the drop across this resistance measures the voltage between the neutral point and earth, so that the neutral point is not fixed definitely but depends upon the amount of resistance and the current flowing through it.

With the earthed neutral very simple and reliable apparatus can be provided, which will cut out any feeder in case an earth occurs upon it. This apparatus may be of the Merz-Price balanced protective type, or it may be of that type which is based upon the principle that the resultant current in a three-phase circuit is zero. Fig. 1 shows a well-known arrangement of this kind. It is evident that under normal conditions the resultant current in the secondaries of the three transformers is zero, therefore no current can flow through the trip coil; but should an earth occur on one of the wires, the circuits will be unbalanced and current will flow through the trip coil. This apparatus may be adjusted to work on a very small earth current.

Still another possibility is to put a trip coil in series with the earth connection, but this arrangement is not so satisfactory as those previously mentioned, in that it does not discriminate as to the feeder to be cut off.

Where a large cable network is supplied from common bus-bars the arrangement shown in fig. 1 may work satisfactorily without the neutral point being earthed. The reason for this is as follows:—

In the event of an earth on any wire, the charging current to earth on all of the cables on the system will be returned to the bus-bars through the wire which is earthed. Therefore the current balance on the earthed feeder will be upset and the circuit-breaker operated. This arrangement is, however, limited in its application, and is not so positive as when there is a current flow between earth and generator neutral.

All modern three-phase generators are insulated to stand operation without the neutral being earthed, so that no consideration of reduced first cost due to limiting the voltage to earth by earthing the neutral need enter the problem. The question of risk of breakdown with earthed or unearthed neutrals may also be practically neglected. Three classes of service will be considered:—

(*a*) Generator supplying network of underground cables.

(*b*) Generator supplying overhead transmission circuits without transformers.

(*c*) Generator supplying overhead transmission line through step-up transformers.

In case (*a*) an earth on any phase of a cable is almost certain to develop into a short-circuit between phases, and on a large system the result of a short-circuit on a cable is usually to burn off a section of the cable, perhaps to damage adjacent cables, and sometimes to set up surges which may cause serious breakdowns elsewhere on the system. Since the majority of breakdowns on cables are to earth, it is therefore extremely desirable that a cable be cut off as soon as an earth develops, and as this can be done quickly and with certainty where the generator neutral is earthed, it is becoming general practice to do this in all stations of this class. Thus practically the only question to consider is whether the neutral shall be earthed solidly or through a resistance, and, where there are several generators in parallel, how many of them should be earthed. The only object in inserting resistance between generator neutral and

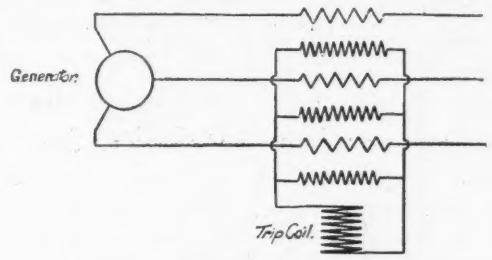


FIG. 1.—BALANCED PROTECTIVE GEAR.

earth is to limit the rush of current which occurs whenever there is an earth on the system. If balanced protective apparatus is used, similar to that shown in fig. 1, the resistance may be made so high as to keep down the current rush to a comparatively low value, because the protective apparatus may be set to operate with a very small unbalancing in current; but where plain overload protection is used—and this applies to the majority of cases—the resistance should be low enough to pass sufficient current to trip the breakers on the largest feeder, but high enough to prevent damage to generator windings, and, if possible, to prevent serious burning at the point of accidental earth.

In general, earthing resistances are built up of cast-iron grids mounted on porcelain insulators, and should be located in a fireproof compartment. They are usually designed to have sufficient heat capacity so that full star voltage may be maintained across them for at least 15 seconds without a temperature rise of approximately 300° C. being exceeded. The ohmic value of the resistance is determined by the current required to trip the breakers on the largest feeder.

Where it is desired to earth through a resistance, and two or more generators are operated in parallel, the simplest and best method is to connect the neutrals of all the generators to a common bus-bar which is earthed through a suitable resistance. Then, regardless of the number of generators, the value of the earth resistance will always be the same. With this arrangement switches must always be provided between each generator and the neutral bus-bar, otherwise a generator disconnected from the main bus and shut down may be raised to a dangerous potential above earth, in case of an earth on any feeder. The objection to this method of connection is that in certain cases very heavy currents may circulate through the neutral connections and generator windings. It should be noted, however, that the neutral current divides equally among the three-phases of the generator. With 30 per cent. of full-load current in the neutral the resultant heating in the generator is increased by only 1 per cent. at full load and is quite negligible.

It would seem advisable, therefore, to try connecting the generator neutrals solidly together, especially in the case of turbo-generators, which there is no angular variation in speed, and therefore less chance of circulating currents. Should satisfactory operation be impossible, then only one generator should be connected to the neutral bus, or resistance may be inserted between each generator and the neutral bus.

(*b*) In this case there are usually a comparatively small number of transmission lines, and an earth on one wire is not likely to cause a short circuit between wires, so that with an unearthed neutral it is quite possible to run for a long period with one wire earthed. If there are not sufficient feeders to all distributing centres to make it possible to cut out a defective one and deliver full load over the others, the possibility of being able to operate with one wire earthed may be sufficient far to outweigh the only practical advantage gained by earthing the neutral, which is the ability quickly to cut off a feeder in the event of an earth upon one wire. In the majority of cases the weight of the argument is in favour of operating with the generator neutrals unearthed.

(*c*) In this case there are conditions involved which make it extremely desirable to earth the neutral or else to earth the low-tension side of the transformers.

If one terminal of the high-tension side of a single-phase transformer be connected to a high-tension line, and the low-

tension be open-circuited, the high-tension winding assumes a potential above earth equal to that of the line to which it is connected. The high-tension winding then acts as one plate of a condenser, with the low-tension and core as the other plates. The low-tension winding also has static capacity to the iron, and it will therefore assume a potential above earth, the value of which will depend upon the relation between its capacity to the high-tension winding and its capacity to earth. In practice it may easily assume one-half the potential of the high-tension winding (see fig. 2).

If—K = capacity between high-tension and low-tension, K_1 = capacity between low-tension and core, V = voltage of high-tension line, V_1 = potential of low-tension winding above earth,

$$V_1 = V \times K/K_1.$$

If both terminals of the high-tension winding are connected to the high-tension lines, the resultant potential of this winding above earth will be zero, and the resultant potential of the low-tension winding above earth will also be zero. If, therefore, one terminal of a transformer be connected to or disconnected from a line before the other, the low-tension winding during this period may assume a very high potential above earth and its insulation be broken down to earth. When the low-tension winding is connected to a generator, the generator winding also has capacity to earth, so that the capacity of the low-tension winding to earth is increased by this amount, and its voltage correspondingly reduced. If the capacity of the generator winding to earth = K_2, then the voltage of the low-tension circuit above earth = $V \times K/(K_1 + K_2)$. Thus, while the voltage is reduced by connecting the transformer and generator windings together, it may still be dangerously high.

When both terminals of the high-tension winding are connected to the line, and one wire is earthed, the resultant voltage of the

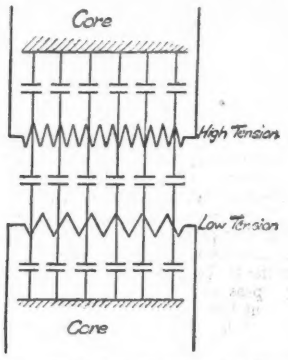


Fig. 2.—Electrostatic Capacity between Coils and between Coils and Core of a Transformer.

high-tension winding above earth will be $V/2$, and that of the low-tension winding will be one-half as great as before, but may still be dangerously high.

In the case of a three-phase transformer the conditions are much the same as described above for a single-phase transformer.

It is evident that when the neutral of the high-tension system is unearthed there are several possibilities of obtaining a high voltage on the generator windings, viz., in the case of an earth on one high-tension wire, or in the case of the switches in the three phases not operating simultaneously.

A case is on record where several generators in parallel were supplying a very high-voltage line through step-up transformers. The neutral point of the generators was unearthed. The lightning arresters on one high-tension phase broke down, and the generator windings were raised to a high potential. One generator broke down, and the attendant, seeing smoke, cut it off the bus-bars. A second machine immediately broke down, and was in turn cut off. This was repeated until nearly all the generators in the station were broken down. The attendant then cut off the excitation. Had the neutral point of the generators, or that of the high-tension side of the transformers been earthed, the trouble could not have occurred in the generator circuit. There is, however, a chance of similar trouble even when the high-tension neutral is earthed, provided the generator neutral is unearthed. This occurs when the insulation between the high and low-tension windings of the transformer breaks down at one point. The low-tension winding then assumes the potential of the high-tension winding at the point of connection, and a breakdown on the low-tension system is almost certain to follow.

Where it is considered undesirable to have a direct connection between low-tension windings and earth, a spark-gap may be placed in the circuit and set to break down at a pressure slightly above the normal voltage of the winding above earth.

The use of earth shields between primary and secondary windings is now scarcely ever called for.

Thus in the case of generators supplying a high-tension transmission line through transformers, it is highly desirable to earth the neutral point of the generators, and preferably through a rather low resistance. If it is not desired to connect permanently to earth, then a spark-gap should be used in the earth connection.

The arguments in favour of earthing the neutral in the case of high-voltage transmission circuits are:—

(*a*) The possibility of cutting off the circuit in the case of an accidental earth on any wire.

(*b*) Reduced cost of transformers and of line insulators due to limiting the voltage above earth to 58 per cent. of line voltage.

(*c*) Reduced cost and closer possible setting of lightning arresters.

(*d*) The possibility of using the earth as a conductor in the event of one line wire being disabled. This requires an earth at both ends of the line.

The argument against earthing the neutral is that an earth on one wire makes it impossible to transmit over the circuit.

(*a*) Whether there is any advantage in being able to cut off a circuit in the event of an earth on one wire depends upon the number of circuits available. In general, there are seldom more than two circuits to any sub-station, and often there is but one, so that cases may often arise where, to keep up the supply, it will be absolutely necessary to operate with one wire earthed. This method of operation would be impossible with an earthed neutral. Also an earth on one wire is not likely to develop into a short-circuit between phases, so that there is no particular need for cutting off the earthed circuit.

(*b*) The higher the voltage of the transmission the greater will be the saving in first cost made by insulating the transformer for 58 per cent. of the line voltage and by using line insulators for a corresponding voltage; but in general it is bad practice to adopt this expedient, for it may prove impossible to operate continuously with an earthed neutral, due to disturbances on adjacent telephone circuits which may occur under certain abnormal conditions, and in the event of an earth on one wire it may be essential to remove the neutral connection and operate with one wire earthed. In general it is poor economy to cut down insulation on either lines or transformers.

(*c*) If the system may sometimes be operated without earthed neutral the lightning arrester equipment must be suitable for this condition, so that there is no saving in first cost; but as long as the system is operating properly with earthed neutral the arresters may certainly be set for lower discharge values than when the system is unearthed.

(*d*) In the event of one wire on an earthed system going to earth, it would still be possible to transmit approximately two-thirds the full amount of power over the two remaining wires, provided the neutral points at both ends of the line were solidly earthed and one line with its corresponding transformers cut out of circuit. In this case the earth would carry full line current, and in very few places would this be allowed on account of disturbances to neighbouring circuits.

The neutral point of a high-tension system can be obtained only by connecting the high-tension windings of the transformers in star, or by the use of an auto-transformer, and this latter method is seldom, if ever, used. If the high-tension windings are connected in star, then damage to one transformer disables the whole group, while with the delta connection on both windings one transformer of the group may be cut out and approximately two-thirds the capacity supplied from the remaining transformers. (This does not hold in the case of three-phase core-type transformers, but is true for single-phase and three-phase shell-type transformers.)

The conclusions to be drawn from the above are that in the great majority of cases continuity of service will demand that the system be operated with an unearthed neutral, and that in general the transformers should be connected in delta on both high-tension and low-tension windings.

When it comes to a study of the question of low-tension distribution circuits, the majority of the arguments presented above will apply here also, but there enters one other consideration, *i.e.*, the danger to human life.

If the neutral point of, say, a 500-volt system is earthed, then the maximum potential above earth which any point of the system can reach is 290 volts. If the system is supplied from a 500-volt generator, the difference between a 500-volt and a 290-volt shock may mean the difference between life and death, or it may not, and there is certainly greater risk of shock from a system which is permanently earthed than from one which is earthed only occasionally. The higher the voltage of the generator the less will be the value of the earthed neutral in preventing danger to life due to reducing the voltage to earth.

When the distribution circuits are supplied through step-down transformers, there is always the possibility that the low-tension circuits may be raised to a very high potential, either through an earth on one wire of the high-tension system, or through a connection between high-tension and low-tension inside the transformer. In the former case there is great danger to low-tension insulation, and in the latter there is danger to life as well as to insulation.

Thus, where the distribution circuit is supplied direct from a generator, the advantages of the earthed neutral are the ability quickly to cut off a defective circuit and a possible reduction in risk to life, due to lower maximum voltage to earth: but where the circuit is supplied through step-down transformers from a high-voltage line there is danger to life and apparatus if the neutral is unearthed.

Where a single-phase circuit is supplied from a single-phase transformer, the low-tension winding should be earthed, preferably at the middle point of the winding, but it is better to earth one line wire than to leave the system unearthed.

Discussion in London.

This paper was discussed in London on November 28th, when Mr. H. Brazil, the first speaker, voiced his agreement with the greater part of the paper, particularly with the view that the neutral should be earthed. His company originally started with the neutral insulated, but had had eventually to revert to earthing,

which in conjunction with lightning arresters—which were much more reliable with the earthed system—had been very satisfactory. While convinced of the necessity of earthing the neutral, he felt that this should be done through a resistance, otherwise it would give rise to excessive currents and would lead to surges. Iron had a positive heating coefficient and was not the best material for the resistance; its resistance increased enormously when heated, whereas a material such as carbon, with a negative coefficient, was much preferable. He described a resistance built up of 72 rectangular fireclay troughs containing carbon powder, arranged eight sets in parallel, each set consisting of nine in series, and giving 200 amperes with a fault. This has been installed at the Lancashire Power Co.'s station, and has avoided the trouble experienced with iron resistances. Further, a rearrangement of the troughs enabled the tripping current to be adjusted. With iron resistances as much as 750 amperes passed, and it was evident that under present conditions the effect on the system was much less severe.

Mr. W. A. Chamen said in the South Wales system they had earthed the neutral of one alternator only and were going to insert a resistance. The distribution system was both overhead and underground, and in the old days before the precaution of earthing had been adopted, one fault generally led to another. The South Wales sub-stations were equipped with three single-phase transformers coupled in delta, and as it made no difference in insulation, he thought it would be advantageous in colliery supply to earth one phase. For lighting supply three-phase transformers were employed with four-wire circuits, and the neutral was solidly earthed.

Mr. G. W. Partridge said it appeared to him that earthing one-phase would get over difficulties and would cheapen the switchgear required, as there would be only two phases to be equipped. He was doing this himself, and was surprised that the author had not mentioned it in his paper. He agreed that earth shields in transformers were undesirable, and that in the case of distribution circuits supplied through transformers it was very necessary to earth in view of the possibility of the secondary system getting charged up and people receiving shocks. He felt that in the case of a sub-station above a certain capacity there should be some direct path back to the generating station as well as the earthed neutral, as there might be such local resistance at the earth plate that the ground in the vicinity became dangerously charged. He suggested a connection from the earth wire through a spark gap to the earth shield of the H.T. cable on the primary side.

Mr K. Edgcumbe referred to the advantages of having some means of telling how the insulation of the system was going on from day to day, which in the insulated system could be met by connecting an electrostatic voltmeter between each main and earth. With high pressures the voltmeter was connected through a condenser, and the arrangement was quite satisfactory; he knew of 200 electrostatic voltmeters in use on a 7,000-volt system in the Midlands which had given no trouble. On an earthed system similar means could be found; an ammeter could be connected across the poles of the transformers in the protective gear, and transformers would have to be provided in any case.

Mr. J. Shepherd considered that in very few cases would it be possible to connect solidly together all the machine neutrals. The difference in potential of the neutrals was as much as 500 volts in some cases. The earthing resistance installed at the Greenwich tramways generating station of the L.C.C. (and described by Mr. J. H. Rider in a paper before the Institution, in 1909), cost £120, and had a capacity of 500 amperes, while the automatic switch cost £45, and the arrangement had been perfectly satisfactory.

Mr. Brazil said the cost of the resistence referred to by him was about £40; it was designed for 1,200 kw. when cold and 2,000 kw. at the end of one minute.

Mr. C. P. Sparks said his experience was practically confined to earthed neutrals; they were essential in every case of overhead mains for the protection of the public. With unearthed neutrals, one breakdown caused another, through surging.

Mr. A. P. Trotter said that while earthed neutrals were commonly adopted here, yet a good many stations had been run with free neutrals until circumstances led them to earthing. With overhead lines the conditions were peculiar, and it might be worth while with a long line to have a free neutral and run on a fault. In this country, however, the distances were short, and this enabled one to effect repairs quickly, so that the conditions were different. In view of the necessity of securing safety in the case of overhead lines in populous districts, he would like to see some form of trip provided in the earthed neutral which would shut down the line with the minimum current flowing to earth.

Mr. S. L. Pearce said that at Manchester they started in 1901 with unearthed neutrals, and the arrangement continued to the present day. The problem had not been studied then as now, and it was, no doubt, considered that the insulated system was safer, and that it offered the possibility of running with one phase earthed; and this had been borne out in practice. Under present conditions, however, there was nothing to chose between one system and the other at Manchester, and it had been decided at an early date to earth the neutral in order to limit the current to earth. As there was 45,000 kw. at Stuart Street behind a fault, it was rough on the switch which interrupted the circuit. He proposed to combine earthing through a high resistance (giving about 100 amperes) with balanced protective gear, such as was shown in the paper. The resistance would be proportioned to allow sufficient current to trip the largest circuit-breaker.

Mr. J. S. Peck, in replying to the discussion, asked whether there was any change in the value of the carbon resistance referred to by Mr. Brazil, and was informed that there was not. In many cases, he said, manufacturers were able to make considerable reduction in cost of apparatus where earthing was adopted, owing to the limited voltage, but he did not favour this, because apparatus should be capable of working unearthed if necessary. In regard to overhead lines, if it was only a case of a pierced insulator, he saw no reason why the line should not be earthed at the station and run. In the case of a low-voltage system, it did not matter whether one phase or the neutral was earthed, but with step-down transformers, it was better to earth one phase than work unearthed. The tendency on very high-voltage systems seemed to be towards insulated neutrals, and the use of delta-connected transformers. He thought it was doubtful whether earthing should be adopted with the 200 or 400-volt supplies in large industrial works, as it was necessary to keep going and impossible to shut down for temporary earths which frequently occurred.

Discussion at Manchester.

Mr. A. P. Trotter said he had to look at the question from the point of view of safety of human life. The B. of T. regulations permitted the use of a free neutral, which practice he thought came from Germany. Originally, earthed neutral was specified, and after a lengthy experience of high-pressure distribution with free neutral, he was not convinced that the latter method was the best practice. Each case had to be treated on its merits. Personally, he did not wish to recommend that free neutral should be insisted upon at present for high pressure. Coming to low pressures, the case was different, and for distribution circuits at low or medium pressures there could hardly be any doubt except in mines, where conditions were again different. Much trouble was experienced from birds on the overhead lines, and he would like to see a time-limit device employed to meet such cases. There was still plenty of room for devices for leading current to earth. He did not think anyone was likely to repeat the London arrangement for connecting machines to earth, and the plan of putting one machine only to earth was not necessarily reliable. The bus-bars should be earthed rather than the machines. The author stated that it was quite possible to run for a long period with one wire earthed, but he (the speaker) would like to see a shut-down if anything in the way of a permanent earth was developed. There was something to be said on the question of running three-phase circuits with one phase earthed, and one point to be considered was that an interruption of the earth conductor would cause the transformer to become alive. In conclusion, he considered that the time had come when those engaged in overhead-wire construction should look out for some method which would ensure that if a wire fell to the ground it should be cut out at once.

Mr. W. B. Woodhouse thought that generators should be connected together at as few points as possible; if joining the neutral to any machine could be avoided, so much the better. Regarding overhead lines, it was difficult to carry out earthing satisfactorily; the resistance of earth between the point of leakage and the station was an unknown quantity. Earthing overhead systems involved other troubles, such as disturbance to telegraph systems. Even with perfectly balanced systems, the capacity currents caused trouble.

Mr. R. Blackmore cited an experience with three 2,000-kw. turbine sets and a few 500-kw. reciprocating sets which were coupled with the neutral point solid to earth. A feeder went to ground, and almost immediately the stator of one of the machines broke down to earth, due, as he thought, to surging. The feeder was cut out, and some days later, another machine, which had been in service during the feeder fault, also broke down to earth. After careful investigation, it was decided to retain the earth, but through a resistance instead of a solid connection. He felt confident that this was the correct thing to do. Incidentally, when the change-over was being made to insert the earthing resistance, the turbo sets were coupled correctly, but the reciprocating sets were overlooked. In consequence, when the sets were all running in parallel, the earth resistance, which was capable of carrying 300 amperes for 10 seconds, became red hot, showing that there was an enormous interchange of current between the machines.

Mr. A. E. McKenzie said that the Manchester high-pressure system had been running for 10¼ years with the neutral insulated, although, on the occasion of a fault, they had undoubtedly run for a period of one hour with one phase earthed before being able to locate and isolate the faulty feeder. Such circumstances were not permissible at the present time, as, owing to the rapid growth of the system, if one phase was earthed, there would be an immediate breakdown adjacent to the first earth on some other part of the system. This state of affairs had been in existence for about a year, and they had been considering the advisability of earthing the neutral. They would not think of earthing the neutral without a resistance, and presuming it to be designed to carry the current of the largest circuit-breaker, it would have to be of enormous proportions, as the 25-feeder circuit-breakers were set to operate at 600 amperes. He thought they would be better served by a resistance which would open with a small current instead of 600 amperes, and by having balance protection, not necessarily at the gear, as all the feeders had plain overload protection, but protective gear as shown in fig. 1 in the paper. In his opinion fig. 1 was somewhat misleading; it appeared that if the generators were protected as shown in the paper, and a fault occurred between any two phases, all the generators would be thrown off the bus-bars immediately. He could quite imagine this protection on a feeder, but not on a generator. The possibility of cutting off a wire or feeder in the event of an earth, as the author stated, was not confined to an earthed neutral; several years ago two of the Manchester feeders were fitted with Ferranti-Field protective devices similar in theory to that shown in fig. 1, except that a ring transformer was used.

So far there had been no trouble on the feeders referred to. In the early days, although three ammeters were employed, it was rather difficult to locate feeder faults, owing to the fault current being out of phase with the load current.

MR. S. J. WATSON thought that if the safety of the public was the sole study, earthing was desirable, but if the question of continuity of supply was the study, the less they earthed the better. Taking for example the universal practice under Board of Trade Regulations of earthing the neutral of a three-phase L.T. distribution scheme, and the middle wire of plain D.C. distribution, he did not think anybody would earth either neutral or middle wire, unless under compulsion. It was fairly well recognised that a fault on an earthed system meant discontinuing supply, and this, above all other things, was to be obviated. The speaker was at issue with Mr. Trotter in suggesting that some device should be got out which would entirely cut off a high-pressure line when a fault occurred on an overhead transmission. If a line could be kept in service until the supply could be diverted into another feeder, they should continue to supply people through it. He was assured that this view was accepted by supply engineers. He did not earth at all, and so far had not experienced any trouble. A great deal of past trouble in connection with H.T. earthing was due to defects in generator design. It was a simple matter to design an alternator which would not give more than its full-load output, and he thought that this principle might be embodied in the design of future machines.

MR. W. CRAMP asked the author whether it was not possible to use a choking coil of a particular design and so combine the features of dead earth and resistance to earth. The object of resistance was to limit the flow of current particularly at high frequency. A choke coil would do this, and could be so designed as to prevent any surging at all.

MR. E. WEDMORE said he had yet to find out why it was necessary to employ separate resistances for different machines. The reasons given in favour of earthing, particularly the possibility of cutting off any wire or feeder in the event of an earth upon it, were becoming more important every year. A point which fig. 1 did not bring out was that an instantaneous trip device could be put in where the trip coil was shown, which would cut off a set immediately with a small current, whilst time limits on the other feeders would hold out temporary overloads. Disturbances on the system always occurred when a fault in the nature of an arc to earth developed. It was his practice to specify two minutes loading for earth resistances, but in general it was a good deal more than two minutes. The average short-circuit current was capable of clearing itself inside two minutes. A time-limit loading of 10 to 15 seconds was not really safe, as an earth fault on a single generator might cut off the earth resistance just at the most critical moment. He agreed with the author's conclusions. The delta connection of transformers was to be advocated. The majority of faults at the present time appeared to be in apparatus and not in cable.

MR. K. M. FAYE HANSEN said he had more prejudice for earthing than the author. It was very likely that proposals in the direction of balanced protective gear would become more important in time. The reasons given by the author for earthing generators applied equally to transformers for underground networks. Similarly the remarks concerning overhead transmission lines held good for underground lines. Earthing by means of auto-transformers was not very often adopted.

MR. E. M. HOLLINGSWORTH said that, as an engineer running a system with free neutral, he felt rather lonely. He had had no trouble during three years' running, although in one case the spark gaps welded over, and he felt convinced that if he had employed an earthed neutral it would have meant a shut-down.

MR. R. G. CUNLIFFE asked for more information on the question of where, when and how the neutral point should be earthed. He objected to the term "true earth," and suggested "normal earth" as more appropriate.

MR. W. B. SHAW said the term "solidly connected" might be taken to imply that no protection should be employed between the neutral point of the generator and the neutral bus-bars; he thought some device should be used in this position, in order to control the fault current and not leave the generator open to damage. For systems of medium pressure it was a mistake to put resistance in at all. The resistance obtained in an ordinary earth was appreciable, and the current due to a short on a system of medium pressure would not be sufficient to do serious damage, and it was necessary to be certain that the circuit-breaker would act when relying upon an earthed neutral for protection. He agreed with Mr. Trotter regarding the danger of fallen overhead lines, using an earthed neutral.

PROF. MARCHANT said the diagram, fig. 1, seemed to indicate a good circuit for triple-frequency currents Would these operate the trip coil?

The AUTHOR, in reply, said that he and Mr. Trotter appeared to be agreed in general. He did not mean to imply that a system would work with one wire earthed, because usually, especially on large circuits, as soon as they got an earth on one of the wires of a three-phase cable, numerous shorts occurred, and in the case of large systems might cause much damage to generator and apparatus. If Mr. Trotter's suggestion of shutting down whenever an earth occurred was followed, there would be many cases where such procedure would be fatal to the undertaking. In many transmission schemes it would be impossible to run a sufficient number of circuits to ensure continuity of service when one or more lines were broken down. A certain risk must be taken, and if necessary the system should be run with one wire earthed until the supply could conveniently be shut off for repair. Referring to fig. 1, a short between two wires of one phase would affect the trip coil. Life was not always protected by earthing; many cases had occurred where shocks were obtained with neutral earthed. Regarding the use of choke coils, he did not consider that any trouble would be experienced, but resistances had proved very satisfactory, and were probably quite as cheap if not cheaper than chokers. He had heard of several cases where trouble resulted from coupling generators together. Mr. Faye Hansen seemed to lean towards earthed neutrals in cases where he (Mr. Peck) would rather run on free neutral. He contended that when one phase broke down, it operated at normal voltage, and not at double voltage, and he thought that high-voltage apparatus should be built to operate successfully with one side earthed. Regarding Mr. Shaw's remarks on the circuit breaker in the neutral wire, as far as he was aware nothing had been done in this way. He could not say off-hand whether the triple-frequency currents referred to by Prof. Marchant would cancel themselves, or go through the trip coil.

The Effect of Recent Decisions upon the Arbitration Clause.

By W. VALENTINE BALL, M.A., Barrister-at-Law.

(*Abstract of paper read before the* INSTITUTION OF MUNICIPAL ENGINEERS, *on November 27th*, 1912.)

I PROPOSE to consider whether, and by what means, the parties to a contract can make sure that the disputes which may arise during or after the execution of the works shall be referred to an agreed arbitrator, whose decision shall be final.

A form of arbitration clause with which most municipal engineers are familiar is to be found in the form of contract approved by the Royal Institute of British Architects. The difficulty with which it is my object to deal in the present paper is not likely to arise if the R.I.B.A. form is adopted in its entirety, because the arbitration clause which is there used expressly provides that the "architect" and the "arbitrator" shall be two distinct persons.

The question between the employer and the contractor when the contract is being prepared will be: "Whose name is to be inserted as arbitrator?" In recent years the practice has grown up of appointing an engineer or surveyor who is actually in the employment of a municipal or other local authority to act as sole arbitrator under a contract to which that authority is a party. How far may the contractor be compelled to submit to his decisions?

A man cannot enter into a contract on the terms that neither he nor the person with whom he contracts shall have recourse to the legal tribunals of the land. As to arbitration, however, the Courts have long held that the decision of an arbitrator may be made a condition precedent to bringing an action. The jurisdiction of the Courts is not really ousted.

It is obvious that bias clearly proved would be sufficient to justify the Court in refusing to allow a particular man to sit as arbitrator. In order to succeed because of alleged bias a probability, not a mere possibility, of bias must be shown. The mere fact that the arbitrator is the servant of one of the parties is not sufficient to disqualify him; for this is a fact which must have been known when the contract was signed. The Court will be reluctant to revoke a submission to arbitration on the ground of interest. Where the matter in dispute is something in which the arbitrator is only indirectly interested, a reference to him would not be prevented.

It has been held that a mere expression of opinion in favour of one party is not sufficient reason to disqualify an arbitrator unless it appears that he has so made up his mind as not to be open to argument.

It seems that, in considering the question whether a person who is the servant of one of the parties can act as arbitrator in a dispute, the Court will consider the nature of the question which he has to decide. In a case where the company objected on the ground that the engineer did not allow them to have proper facilities for proceeding with the work, the Court of Appeal refused to stay the action, saying that it was not human nature to suppose that he could properly determine that he himself was an unreasonable person.

If the conduct or dealings of the engineer himself are in question, the matter will be taken from his hands.

To summarise the cases to which I have alluded: The contractor will not be compelled to submit to the decision of the employer's engineer as arbitrator (1) if the matter in issue is an unseemly personal dispute raising a vindictive feeling between the engineer and the contractor, and the engineer has so strongly expressed his view that it amounts to a prejudgment; (2) if the nature of the dispute is such that the cross-examination of the engineer is essential; (3) if the matter in issue is something outside the original agreement —*e.g.*, a dispute as to whether the engineer and contractor had agreed to vary the original agreement; (4) if the conduct of the engineer himself is practically the only point in dispute.

Deletion of the arbitration clause would involve recourse to legal proceedings for the settlement of all disputes; but a dispute arising under a building or engineering contract would not come before the Court and a jury, but before a special referee (*i.e.*, an engineer appointed by the Court), or before an official referee. In the result the proceedings would be very similar to those which would take place before the arbitrator named in the contract. It is a trial of this kind which takes place if litigation ensues owing to the failure of an arbitration clause. Save that a reference to an official referee is reference to a lawyer, it very much resembles a reference to arbitration.

Reference to an independent arbitrator appears to present almost if not quite as many objections as a reference to the Court. It is wise, if it is desired to have an independent arbitrator, to leave him to be selected by agreement when the dispute arises, or, failing

agreement, to be nominated by some eminent engineer of known capacity.

I venture to make the following suggestion: Frame the arbitration clause so as to leave the decision of every question arising under the contract to the engineer, but subject to a proviso that, should it appear to the Court on an application to stay any action or proceeding brought in relation to the contract that the engineer is disqualified from acting as arbitrator, the matters in dispute will be referred to an engineer, to be agreed between the parties, or, failing agreement, to be nominated by the president of the Institution of Civil Engineers. Another alternative is suggested by Mr. E. J. Rimmer; it is that, while preserving the finality of the decision of the engineer upon certain special points, a proviso should be added to the arbitration clause, stating that if any action is brought the defendant may either (*a*) have the action stayed and remitted to the engineer, or (*b*) have the matter referred to an independent arbitrator appointed in one or other of the manners above suggested.

What the local authority, which is responsible to the ratepayer, desires in relation to a contract is certainty in the matter of price and time; certainty that work shall be done under trustworthy supervision; and reasonable certainty that disputes shall be settled economically and expeditiously by a man in whom it has confidence. The suggestions I have put forward may, if adopted, avoid a good many of the pitfalls laid bare by the cases which I have cited.

NEW ELECTRICAL PROPOSALS FOR PARLIAMENT TO CONSIDER.

We give below, in our usual form, brief particulars of new lighting, power, and traction proposals that have formed the subject of notices published in the last few issues of the *London Gazette*. These will, if they survive the usual preliminary stages, occupy the attention of Parliamentary Committees early in the new year:—

(*a*) Electric Light and Power.

Baildon.—Electric lighting powers are sought by the U.D.C.

Barnet.—North Metropolitan E.P.D. Co., Ltd., extension powers, parish of Arkley.

Barton-on-Humber.—Mr. F. Hopper, Elmtree House, Barton-on-Humber, seeks electric lighting powers.

Basingstoke.—Corporation seeks electric supply powers within the borough and certain parishes in the Rural District.

Beckenham.—Application by U.D.C. for prov. order extending area to include West Wickham.

Caerphilly.—Application by Mr. J. H. Edwards, 127, Victoria Street, Bristol, for prov. order.

Chipping Norton.—Mr. W. A. Schultz (C.N. Electric Supply Co., 50, Cannon Street, E.C.) is applying for a prov. order.

Cleveland and Durham County.—C. and D. County Electric Power Co. seeks powers for acquisition and working of generating stations of other companies, for supply to authorised distributors, for supply of electric apparatus, &c.

Colne.—Corporation seeks extension of electricity supply area, also powers to acquire the Colne and Trawdon Light Railways undertaking.

Colne Valley.—C.V.E.S. Co., Ltd., seeks powers for supply in Pinner, Bushey, Chorley Wood, Rickmansworth, &c.

Coventry.—Corporation, area of electricity supply. Motor-omnibus powers.

Crowborough.—C. District Gas Co. seeks electricity supply powers, to erect generating station, supply in bulk, &c.

Cwmamman.—U.D.C., electric supply powers.

Derby.—Corporation, extension of supply area to include various parishes in Shardlow, Belper and Repton Rural Districts.

Dartmouth.—Urban Electric Supply Co., Ltd., extension of area to U.D. Brixham, &c.

Doncaster.—Corporation is seeking electric supply powers for the Urban Districts of Bentley-with-Arksey and Balby-with-Hexthorpe.

Ellesmere Port and Whitby.—Application by U.D.C. for electric lighting powers.

Ely Valley.—New company seeks power to supply gas and electricity, construct generating station, purchase and supply in bulk.

Epsom.—U.D.C., provisions as to supply of electricity, electrical fittings, &c.

Feltham and District.—Application by Mr. F. H. Edwards, Mandeville, Platt's Lane, Hampstead, for power to supply in Feltham Urban District and adjoining places in Middlesex.

Grays and Tilbury.—G. and T. Gas Co. seeks power to apply for prov. orders for electricity supply.

Hazel Grove and Bramhall.—Powers are sought by the U.D.C. to purchase or produce electricity.

Herne Bay.—H.B. Gas and Coke Co., Ltd., seeks powers for transfer from U.D.C. of electric light order, 1909.

Hove.—Corporation, purchase of undertaking of H. Electric Lighting Co. Extension of supply area.

Itchen (Southampton).—Electric supply powers to U.D.C.

L.C.C.—Powers to Metropolitan Borough Councils to attach brackets to buildings for public lighting.

Leatherhead and District.—Extension of area of L. and D. Electricity Co. to include portions of Epsom and Dorking Rural Districts.

Marlborough.—Application for prov. order by M.E.S. Co., Ltd.

Menai Bridge.—M.B. Electricity Supply Co., Ltd., prov. order for Urban District of Menai Bridge and parish of Llandegfan.

Mid-Sussex.—The M.-S. E.L. and P. Co., Ltd., is applying for electric supply powers for the Urban Districts of Cuckfield and Hayward's Heath, &c.

Morley.—Further powers are sought by the Corporation in respect of its electricity undertaking.

Neath Rural District.—Application by R.D.C. for extension of electric supply area.

Northern Counties E. Supply Co., Ltd.—Confirmation of agreements between the company and Hebburn and Felling U.D.C.'s, also County of Durham and Newcastle-upon-Tyne E.S. Companies.

Northwood and Ruislip.—Northwood E.L. and P. Co., Ltd. Extension of supply.

Porthcawl and District.—Porthcawl Gas Light and Coke Co., Ltd., various powers, including electric generating station and supply of electricity within gas limits. Supply of electricity in bulk. Application of capital for electrical purposes.

Rickmansworth, Chorley Wood and District.—Application by R. E. H. Fisher, solicitor, of Chorley Wood, for electric supply powers.

Romford.—Application by Mr. W. T. Pressland, 11, Tothill Street, Westminster, for prov. order to supply within the Urban District.

Romford and District.—County of London E.S. Co., Ltd., powers to supply Romford and Tilbury, &c. Supply in bulk in Urban Districts of Barking Town, Grays Thurrock, Ilford and Romford.

St. Annes-on-the-Sea.—Application by U.D.C. for extension of supply area so as to include Lytham U.D.

Sevenoaks and District.—S. and D. Electricity Co., Ltd., Salisbury House, E.C., is seeking supply powers within the Urban District and various parishes in the Rural Districts of Sevenoaks and Godstone.

Skelton and Brotton.—Electric supply powers to U.D.C.

Smethwick.—Birmingham District Power and Traction Co., Ltd., repeal or amendment of Smethwick 1898 order. Transfer of powers, supply of electricity in bulk.

Southborough.—U.D.C. seeks electric lighting powers.

South Staffs.—Mond Gas, Power and Heating Co., powers as to capital rearrangement. Co-partnership scheme and benefit fund for employés.

Stoke-on-Trent.—Corporation seeks powers extending area to include part of Wolstanton, not in 1899 order.

Stroud (Glos.).—Application by Mr. J. H. Edwards, 127, Victoria Street, Bristol, for a prov. order.

Tottenham and Edmonton.—T. and E. Gas Light and Coke Co. seeks powers to take over Wood Green E.L. Order and incidental powers.

Truro and District.—T. Gas Co. seeks powers to supply electricity.

Truro.—Corporation seeks electric lighting powers.

Watford.—U.D.C., extension of supply to several parishes in the Rural District.

Weaverham.—W. Electricity Supply Co., Ltd., is applying for prov. order for electricity supply to various parishes in the Rural District of Northwich.

Wellingborough.—W.E.S. Co., Ltd., power to purchase lands and erect generating stations.

Westgate and Birchington.—W. and B. Gas Co., electricity supply powers and extension of gas area.

Whitstable.—Application by Mr. C. Campbell, 37, Cromwell Road, Whitstable, for a prov. order.

Wolverhampton.—Corporation, extension of supply area to include Bushbury. Repeal of the Midland Electric Power, Distribution and Lighting and Extension Order of 1900.

Wood Green.—North Metropolitan E.P.D. Co., Ltd., electric supply powers.

York.—Corporation, further electrical powers. Lands for electricity undertaking.

(*b*) Electric Tramway and Railless Trolley Vehicles.

Baildon.—U.D.C. seeks tramways prov. order.

Birmingham.—Corporation, motor-omnibus powers; also use of coupled and trailer tramcars.

Bradford.—Corporation, new trolley vehicle routes.

Brighton.—Transfer to Corporation of undertaking authorised by Brighton, Hove and District Railless Traction Act, 1911. New trolley vehicle routes, motor-omnibus powers.

Chesterfield.—Corporation, trackless trolley powers within and without the borough. Motor-omnibus powers. Further powers for electricity supply.

Derby.—Corporation, tramway, motor-omnibus, trackless trolley vehicle powers.

East Ham.—Corporation, use of trailer cars on tramways. Various electric supply provisions, &c.

Folkestone, Sandgate and Hythe.—F.S. and H. Tramways Co. seeks power to abandon tramways, and release from liability. Release of company and National Electric Construction Co., Ltd., from certain obligations. Change of name of company, and power to run trolley vehicles in Folkestone, Hythe, Sandgate and Cheriton.

Lancaster.—L. and District Tramways Co., Ltd., reconstruction of tramways, &c.

Leeds.—Corporation, new tramways and trolley vehicle routes within and without the city. Electric generating station.

Leicester.—Corporation, new tramways, motor-omnibus powers, extension of electric supply area. Power to let out on hire electric motors, and cooking and heating apparatus, and arc lamps.

Halifax.—Corporation seeks powers for new tramways and tramroad in the boroughs of Halifax and Brighouse, and some Urban Districts in the West Riding.

Hastings.—H. Tramways Co., seeks power to work Tramway No. 1, authorised by 1903 Act, by overhead system. Repeal of provisions of 1903 Act.

Huddersfield.—Corporation, powers for tramways in Huddersfield, Brighouse, Elland and other places in the West Riding. Also trolley vehicle and motor-omnibus powers.

L.C.C.—Construction of new tramways and subway. Trackless trolley vehicles and other powers.

Metropolitan Electric Tramways, Ltd.—Trolley vehicle powers for Tottenham, Wood Green and Walthamstow. Transfer powers to local authorities, &c.

Mexborough and Swinton.—Powers to M. and S. Tramways Co. to work railless trolley vehicles in Mexborough, Swinton, Wath-upon-Dearne and other Urban Districts and Parishes.

Morley.—Corporation seeks authority to run railless electric traction system on defined routes.

Newcastle-on-Tyne.—Corporation, construction of new tramways.

Nottingham.—Corporation, tramway and motor-omnibus powers. Also trackless trolley vehicles within and without the city.

North Lindsey Light Railways Co.—Light railways amendment order.

Rhondda.—R. Tramways Co., Ltd., seeks power to work railless trolley vehicles in parish of Llantrisant, also power to B. of T. to sanction other routes. Electric supply agreements.

Southport.—Corporation, additional tramway powers, trolley vehicles, omnibuses.

West Bromwich.—Corporation, powers for running trolley vehicles and motor-omnibuses. Further provisions as to electricity undertaking.

Western Valleys, Monmouthshire.—New company to run trolley vehicles from Brynmawr to Newport, Mon. Construct generating stations, agreements with local authorities and others as to supply of current. Running powers over Newport Corporation Tramways.

(*c*) Railways.

Central London Railway.—New railways and works, agreements with L. and S.W.R. and other railway companies. Additional capital and other financial powers.

City and South London Railway Co.—Powers to enlarge tunnels, enter into agreements with other railway companies as to construction of works, power to re-equip railway out of capital, rearrangement of existing and authorising of additional capital.

London Electric Railway Co.—New railways and works, running powers over City and South London Railway, &c.

Metropolitan District Railway.—Powers to widen at Parson's Green, to enter into an agreement with Metropolitan Railway, confirmation of agreements with Wimbledon and Sutton Railway, emergency supply of electric power, &c.

Metropolitan Railway.—Transfer of G.N. and City Railway Co. Supply of current to other companies.

NEW PATENTS APPLIED FOR, 1912.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

26,396. "Electric motors." G. E. Thomas. November 18th. (Complete.)

26,412. "Arrangement of the running gear of electrically-driven or other self-propelled tramway cars or other vehicles or machines running on rails, and having their direction determined thereby." J. Murgatroyd. November 18th.

26,430. "Electric hauling plant." Akt. Ges. Brown, Boveri et Cie (Convention date, November 17th, 1911, Germany.) November 18th. (Complete.)

26,439. "Electric meters and meter systems and relays adapted to control the same and for other purposes." Siemens Schuckertwerke G.m.b.H. (Addition to 25,831/12. Convention date, November 17th, 1911, Germany.) November 18th. (Complete.)

26,443. "Means for setting the timing gear of electrical ignition systems." J. E. Sturgeon. November 18th. (Complete.)

26,457. "Devices for adjusting the length of the spark-gaps between electrodes." O. Imray. (Compagnie Générale Radiotélégraphique, France.) November 18th. (Complete.)

26,469. "Magnetic compasses for use on aeronautical machines." J. F. A. Trotter. November 18th.

26,474. "Spreaders for telephone-receiver casings." P. M. Cox. November 18th. (Complete.)

26,485. "Apparatus for electric sterilisation." K. Gasiorowski. November 19th. (Complete.)

26,499. "Automatic telephonic apparatus." B. Degenhardt. November 18th. (Addition to 3,978, 1912. Convention date, November 18th, 1911, Germany.) (Complete.)

26,502. "Electric alarm clocks." F. Goss. November 18th. (Complete.)

26,504. "Method of and means for cleaning electroplating and finishing surfaces, more particularly surfaces *in situ*." G. P. M. Lee and W. A. Brame. November 18th.

26,509. "Mechanical device for obtaining and timing the sparking in petrol and other engines to which it may be found applicable." C. Porter. November 19th.

26,517. "Electrical switches." A. Wynne. (Divided application on 18,195, 1912. June 5th.) November 19th.

26,548. "Incandescence filament lamps." J. R. Quain. November 19th.

26,579. "Telephones, phonographs, and such like apparatus." A. S. Bowley. November 19th.

26,597. "Automatic regulators for dynamo-electric machines." British Thomson-Houston Co., Ltd, and A. H. St. Croix Watson. November 19th.

26,611. "Safety starting device for petrol and petrol-electric cars." W. A. Stevens. November 20th.

26,639. "Method of testing electrical apparatus." C. Sarel. November 20th.

26,646. "Apparatus for starting internal combustion engines and for generating current for lighting and other purposes." C. A. Vandervell and A. H. Midgley. November 20th.

26,651. "Adapter-holder for use in electric lighting, power and heating." C. C. Smith. November 20th. (Complete.)

26,657. "Telephonic apparatus." G. A. Meyer-Henniger (Firm of). (Convention date, November 20th, 1911, Germany.) November 20th. (Complete.)

26,671. "Electrical switches." B. D. Horton. November 20th. (Complete.)

26,680. "Electric rotary converters." British Thomson-Houston Co., Ltd., and F. P. Whitaker. November 20th.

26,681. "Device for automatically stopping electric hoists." British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Ges., Germany.) November 20th. (Complete.)

26,699. "Dry electric batteries." J. Bohle and "Volta" Commanditges. fur Elektrische Kleinbeleuchtung. November 20th. (Complete.)

26,716. "Electric lampholders and fittings." F. S. Miller. November 21st.

26,720. "Apparatus for the electro-deposition of metals on wire." W. Barron and C. A. Barron. November 21st.

26,732. "Alternating and direct current organ-blowers." F. C. Judges. November 21st.

26,752. "Methods of and apparatus for charging storage batteries." D. H. Wilson. (Convention date, November 21st, 1911, United States.) November 21st. (Complete.)

26,765. "Method of and means for holding tubes, rods, bars, and other articles in position to be electroplated." G. P. M. Lee and W. A. Brame. November 21st.

26,781. "Sound reproducing apparatus." W. H. Derriman. (Automatic Enunciator Co., United States.) November 21st. (Complete.)

26,782. "Telephone systems." W. H. Derriman. (Automatic Enunciator Co., United States.) November 21st. (Complete.)

26,809. "Means for the interruption of electric circuits." British Westinghouse Electric and Manufacturing Co., Ltd. (Westinghouse Electric and Manufacturing Co., United States.) November 21st. (Complete.)

26,823. "Dynamos." F. B. Lodge and A. M. Lodge, trading as Lodge Bros. & Co. November 22nd.

26,845. "X-ray attachments for automobiles." E. B. Hazleton. November 22nd.

26,846. "Magneto-electric machines." H. C. H. Smyth. November 22nd.

26,893. "Voltage regulators for dynamos." A. P. Froger. (Convention date, November 23rd, 1911, France.) November 22nd. (Complete.)

26,899. "Regulation of electric rotary converters." British Thomson-Houston Co., Ltd., and P. Whitaker. November 22nd.

26,900. "Moulded materials and process of making same." British Thomson-Houston Co., Ltd., (General Electric Co., United States.) November 22nd.

26,904. "Electrical-indicating, recording and like arrangements." E. A. Graham and W. J. Ricketts. November 22nd.

26,912. "Starting switches for electric motors." V. G. Middleton, C. J. Baker and F. Farndon. November 22nd.

26,935. "Solenoids for alternating currents." C. G. Major and Smith, Major & Stevens, Ltd. November 23rd.

26,947. "Memorandum and like appliances for use in connection with telephones and for other purposes." E. F. M. Bransom and F. H. Bowden, trading as Bramson & Bowden. November 23rd.

26,948. "Apparatus for heating water by electricity." G. R. B. Middlecoat. November 23rd.

26,953. "Pipe unions and couplings for electric conduit junction boxes and other purposes." F. H. Terry, H. M. Bigwood and Brotherton Tubes and Conduits, Ltd. (Addition to 24,492, 1912.) November 23rd.

26,961. "Electrical instruments." F. G. Waters. November 23rd.

26,964. "Telephone transmitters." F. Gottschalk. November 23rd.

27,011. "Control of fly-wheel electric motor-generators." British Thomson-Houston Co., Ltd., and J. J. Ash. November 23rd.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1911.

System and Apparatus for Preparing Perforated Tape for Telegraphic Transmission of Messages. C. E. Ingram. 10,973. May 6th. (November 6th, 1911.)

Electric Timing Devices. H. S. Hatfield. 24,141. October 31st.

Stand for Supporting and Facilitating the Manipulation of Photographic Electric Arc Lamps and the like. B. A. Quint. 24,300. November 2nd.

Miners' Electric Lamps. E. A. Hailwood. 24,305. November 2nd.

Hand-feed Arc Lamps. L. Kamm. 24,333. November 2nd.

Electric Distribution Systems. G. W. Partridge. 24,386. November 2nd.

Processes for Producing Directive Forces by Induction in Alternating-Current Apparatus. H. Abraham and J. Carpentier. 24,442. November 3rd. (February 25th, 1911.)

Dynamo-Electric Machines. British Thomson-Houston Co., Ltd., and F. P. Whittaker. 24,463. November 3rd.

Lanterns and Lamp Carriers, and Arrangements for Lighting Purposes. H. T. Harrison. 24,486. November 3rd. (Cognate application 9,166 of 1912.)

Apparatus for obtaining a Uniform Longitudinal Seam in Tubes Welded by Electricity. Ges. fur Elektrotechnische Industrie, m.b.H. 24,575. November 4th. (November 5th, 1910.)

Controlling Apparatus for Electrical Lifts. A. W. Penrose & Co., Ltd., and F. Barlow. 24,745. (Addition to No. 1,835, 1911.) November 7th.

Miners' Electric Safety Lamps. O. Oldham. 24,787. November 7th.

Electrical Measuring Instruments of the Induction Type. G. North. 25,086. November 10th.

Means for the Electric Heating of Ovens and other Appliances. C. W. Martin. 26,101. (Convention date not granted.) November 22nd.

Electric Switches. Siemens Bros. Dynamo Works and J. F. Crowley. 26,245. November 23rd.

Holders for Electric Lamps. Frankenburg & Sons, Ltd., and E. Fleming. 26,376. November 25th.